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SAVINGS

FARMERS RECEIVING PROFITS OF ONE YEAR'S LABOR AT THE COOPERATIVE OF HACIENDA POSILLO, ECUADOR, A SETTLEMENT PROJECT IN WHICH FARMERS ARE BUILDING THEIR ASSETS. (FAO PHOTO BY S. LORRAIN)

Towards an Operational Approach to Savings for Rural Developers

J. D. Von Pischke

[The poor people who make up the majority of rural inhabitants in developing countries are often viewed as not being able to save because of their poverty. In fact, they can and do save. The task of institutionalizing rural savings is primarily a question of financial technology, that is of finding ways to provide the financial services that rural savers want and will respond to.]

Savings as a Normal and Continuous Activity

Saving is necessary to finance: assets accumulated through saving are commonly used to finance future consumption or investment. The relationship between saving and finance is most clearly seen through the function or role of finance. As stated by J. W. Paish: "Probably the only living creatures which do not require any form of finance are those for whom the enjoyment of the fruits of their efforts to obtain food is simultaneous with the making of the efforts. For all other creatures there is some interval of time between efforts and enjoyment, and it is for the provision of the means of existence during this interval that we need finance." So, finance is necessary for human survival. The existence of intervals between the realization of income and the act of expenditure is normal and virtually universal. Thus, almost everyone saves.

E. L. Furness lists four reasons why flows of receipts and flows of payments may have differing time patterns:

1) Payment for a continuous service on a continuous basis is frequently inconvenient for both buyers and

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sellers. Convenience favors periodic settlement. For example, riders on public transport are charged once for the journey, not once per kilometer or meter travelled. which would be inconvenient to the point of being impractical. Electric bills are sent once a month.

2) Many commodities are characterized by indivisibilities. They are costly in relation to income earned over a short period, and their purchase requires a build-up of wealth, or payment out of expected future income. To use a rural example, the purchase of a cow or a tractor requires an amount of funds much larger than those involved in every-day transactions in the rural economy. Large purchases are financed by savings and perhaps by credit.

3) Income flows vary over life cycles. For individuals, savings accumulation in the economically most productive years or periods is a rational response to the probability of diminished real income in the future due to illness, old age, uncertainty of employment, etc.

4) Time periods required for production may not coincide with the time periods applicable to producers' consumption and other needs. Most methods of production involve long gestation periods between the start of the production process and the sale of the finished goods, which must be financed so that shorter consuming cycles may continue. Workers may be paid on a weekly or monthly basis in an industry to accomodate them as consumers, regardless of the industry's cycles of production. In an agricultural economy harvests occur once or twice a year, while consumption of agricultural produce occurs continuously.

These examples show that abstention from possible consumption is a normal characteristic of economic activity; and rather than being something left over after expenditure, saving commonly precedes expenditure. Abstention may be for only a very short period: a worker in the city receives his pay on a Friday afternoon and that evening uses part of his pay to take a bus back to his village in the countryside--i. e. the bus fare money was not spent the instant it was received. Economists have not specified what the minimum holding period must be for funds not spent to be considered as having been saved. The usual convention in economic analysis is to treat funds carried over from one period to the next as savings, and economists fix the length of time periods to suit the purposes of their analysis. But in principle any income not disbursed the instant it is received may be regarded as saved until such time as it is disbursed.

The argument presented here is not concerned with the purpose for which funds are eventually spent. The economic definition of saving as abstention from consumption does not specify what type of consumption is involved. In financial terms, funds saved for the

eventual purchase of beer are no different from funds saved to provide for protection against sickness or disability. Money is "fungible," which means that one unit of the national currency has the same essential properties as every other unit. It can be misleading to say that money received from a particular source is used for certain expenditures only. For example, a farmer customarily buys fertilizer for cash and applies it to his fields himself; then one year later he obtains fertilizer on credit and uses the cash he would have spent for fertilizer to hire a laborer to apply the fertilizer. Is it accurate to say that the credit financed the fertilizer? Or the labor?

Towards a Concept of Savings Appropriate for Rural Development

The concept of saving outlined here is direct and uncomplicated. It does not get bogged down in disputes over the period of time or the purpose for which funds are held. Its only requirement is that funds be held. However, it is obvious that funds are held for some reason, and this reason is normally related to the ultimate use of the funds. Saving is, after all, a means to an end, and the ultimate reason for all economic activity is consumption. Consumption usually involves a prior investment of some kind, and investment may be defined for this purpose as behavior in the present (or past) which is (was) designed to increase future production. Only through increased future production can there be increased future consumption. In terms of volume, the largest share of an individual's monetary income is commonly spent for the purchase of goods and services for immediate consumption. However, a portion of monetary income is commonly devoted to investment, and there are two definitions of investment. The first is an economist's definition, which says that investment refers to expenditures for new real or tangible goods, such as new tractors and houses, or for services leading to future production. Such services might include education, or the hiring of labor and machinery for land clearing, levelling, and construction of drainage and irrigation systems, for example.

Money may also be used for investment according to the financial definition, which involves the purchase of financial assets. These assets are claims, evidencing debt or ownership. Debt claims include savings accounts, for example, which are a claim by deposit holders on a bank, post office, cooperative or similar institution. (While the transaction is a sale for one party it is a purchase to another; financial assets have two sides, as assets to buyers and as liabilities to sellers). Debt claims are promises to pay specific sums of money; ownership claims give the holder certain rights of access, use or control. Probably the most common form of ownership claims which are financial assets in rural areas are shares in cooperative societies. Company shares or stocks are the most

common form of ownership claims in economic sectors using large amounts of capital equipment, such as heavy industry or railways.

Money is also used for working balances. Working balances are defined as monetary income which is not yet spent for any of the three purposes discussed above, held primarily for convenience. Money is required to pay for daily purchases; many people keep a little additional money on hand to offer some protection in times of hardship, or unexpected events. In other words, from the standpoint of its owner, some money is temporarily idle or stranded in the flow of economic activity because it is being held for future use. Working balances are clearly savings because they represent abstention from consumption. The "institutionalization" of working balances involves their conversion from cash into debt claims, such as deposits with financial institutions, or other institutional assets.

The Role of the Financial Sector and the Question of Financial Technology

The financial sector is composed of institutions which specialize in creating and processing financial assets:

1) the central bank, which usually issues the national currency and supervises other financial institutions;

2) institutions which accept deposits, such as postal savings banks, savings banks and other thrift institutions;

3) institutions which serve the public mainly by issuing loans, such as hire purchase and agricultural finance companies or funds;

4) financial intermediaries, such as commercial banks and cooperative institutions, which deal with the public by accepting deposits as well as issuing loans;

5) money transfer intermediaries, including national giro systems and post offices, issuing postal orders or money orders and accepting payment orders.

This list is not exhaustive. From the perspective of rural development, traditional institutions like rotating savings and credit associations might be added as a separate category, or classified under one of the above headings.

The manner in which the financial sector creates and processes money is broadly referred to as financial technology. The provision of the means of payment includes the issuing of currency and coin, as well as facilitating transactions between buyers and sellers who do

not deal on a face to face basis but at a distance through some medium of communication such as the postal service, telephone, telex, or other devices, and who use checks and other transactions on bank accounts as a means of payment. A more interesting function of the financial sector is the manner in which it transforms claims by serving as an intermediary dealing in claims. For example, cash deposited with a credit union is transformed at the time of deposit into the depositor's claim on the credit union. The credit union further transforms the resources entrusted to it by depositors into loans to members, also probably into loans to other entities in the financial sector in the form of deposits with commercial banks or perhaps a central cooperative bank, and often in the form of purchases of government securities. It should be clear that these functions and different types of financial claims could hardly exist if there were no savings behavior on the part of the people and organizations receiving income.

It is also apparent that financial institutions tend to be somewhat specialized. In financial terms, specialization is reflected in different types of debt claims issued or purchased. Debt claims exhibit a variety of maturities, rates of interest, minimum denominations, and other characteristics such as negotiability which influence their liquidity--that is, the ease and speed with which they can be converted into cash. These differences determine the level of access which rural people may have to participation in financial markets. Savings account minimum balance requirements which are large in relation to the daily income of agricultural laborers, for example, commonly have the effect of excluding agricultural laborers from the ranks of savings account holders; they may not wish to tie up a number of days' wages in this sort of debt claim on a savings institution. The liquidity and attractiveness of checks and payment orders are reduced when the holder has to travel 50 km to convert them into cash, or when commissions and other fees are large relative to the amount of money transferred. Savings bonds with a maturity of three years may not be attractive to farmers who operate on a seasonal cycle of income and expenditure, unless redemption is permitted prior to maturity without a penalty, or unless there is an active secondary market for bonds not yet mature.

From the perspective of a saver, the attractiveness of debt claims and other institutional alternatives to holding cash depend upon the financial technology involved. Little progress can be expected in bringing the savings--i. e., working balances--of rural people into the formal financial system as deposits until appropriate financial technologies are devised. The product of any financial technology must also be properly packaged to be marketable to rural people.

The nature of the most appropriate packages of rural financial services would vary from case to case because of different underlying cash flow patterns in rural areas. However, some tentative observations may be stated, addressing both the supply and demand sides of the rural savings market.

The supply side of rural savings rests on the situation of the target group of depositors: Under which circumstances are they most likely to entrust their savings to intermediaries in the financial sector? The demand side of rural savings involves the efforts of financial intermediaries to market their services to rural people. What sort of services are likely to appeal to rural people sufficiently to result in their institutionalizing some portion of their working balances? It appears reasonable to assume that deposit accounts are most likely to be used under the following conditions:

1) When target group cash flows are growing. Growth may reflect increasing monetization of rural economy, as well as increasing target group production for the market.

2) When target group income is "lumpy", not spread evenly over time.

3) When intermediaries operate offices convenient to rural people, such as at market locations and on market days. Government compounds, often situated some distance from the center of commercial activities (by colonial administrators for reasons of their own,) obviously offer an intermediary less of a competitive advantage than a site closer to places where rural people frequently engage in cash transactions.

4) When deposits can be made in connection with the provision by the intermediary of other financial services. One important related service is the provision of money transfer facilities. Linking credit access to the existence of a deposit relationship with the borrower or prospective borrower is a useful device from several points of view. It encourages the intermediary to employ local funds locally. It gives the potential borrower greater incentive to accumulate deposit balances. It reduces the lender's risk in two ways: the first is that savings accounts may be used to secure loans; and the second is that the lender acquires more knowledge of his customers by dealing with them as depositors than he would if the only relationship were with customers as borrowers. Linking savings and credit also helps to promote a continuous relationship between intermediary and customer, and the prospect of a continuous relationship gives each an incentive to treat the other party in a businesslike manner, also reducing the lender's risk.

5) When deposits can be made in connection with the provision of non-financial services, such as the purchase of cash crops. Payment for crops presents an opportunity for intermediation because the buyer could establish an account payable on his books or in a bank in favor of the farmer. This account could be transformed into a financial service for the farmer simply by allowing the farmer to withdraw balances in his favor as he wishes, rather than by obliging him to accept the whole of his delivery proceeds in cash. The use of checks as a means of payment inevitably involves a bank or similar institution, which by putting the farmer within the orbit of institutional finance may create improved opportunities for the effective use of deposits and other financial services. However, the use of checks may not be welcomed by the farmer unless he can negotiate them conveniently. In certain cases, checks are inconvenient to everyone except the party ordering the payment, as when farmers must go long distances to cash them or negotiate them through local middlemen at a discount, or when banks are inundated with a large number of small items for payment and clearing.

6) When minimum transaction and balance limits are not too large in relation to the size of daily rural financial transactions by the target group.

7) When the fees, charges and other costs of access to savings facilities are reasonable in relation to the amounts of savings involved in the average transaction.

8) When the intermediary expands the opportunities available to the target group. A new intermediary is unlikely to be successful in attracting deposits if he simply duplicates existing channels or services, especially when the costs of dealing with him are above those of dealing with other intermediaries offering more or less the same financial and other services.

9) When deposit services are operated by intermediaries capable of undertaking planning, promotion, implementation and control.

10) When the intermediary enjoys the confidence of depositors. While some government involvement may help to create confidence, too much government presence may undermine confidence through fear of tax assessments or loss of confidentiality. Confidence almost always requires voluntary participation on the part of depositors.

Interest Rates and the Mobilization of Small Scale Deposits

This essay has not dealt with the role of interest rates in the mobilization of savings deposits. In the rural areas where most

members of the target group do not have deposit accounts, the supply of deposits is initially more "service-elastic" than interest-elastic. That is, people will be more responsive to improved services and access than to higher interest rates alone. The potential advantage for rural people of the use of financial services depends on their safety and liquidity. The alternative to a deposit account may be to keep money in a hole in the ground, the rafters of a house, a tin can or a mattress. At this early stage of financial development, the marketing challenge consists of providing the target group a better means of handling their working balances, of reducing their costs of maintaining liqudity in the form of working balances. These costs tend to overwhelm interest rate considerations in small scale finance, so that convenience is the paramount issue. Given that somé working balances are normally held, the question is largely that of designing services which will result in their institutionalization.

Any intermediary who hopes to be competitive in rural areas must be sensitive to the service mix most suitable for stimulating the institutionalization of small balances. In certain situations it might be unwise to appear to be "discriminating" against small savers by offering them different sorts of accounts or lower rates of interest than larger depositors, in spite of the relatively higher overhead costs involved in servicing small accounts. In most cases, however, many of those presently without access to financial services would probably respond favorably to an innovative savings medium designed specifically to support and facilitate their savings behavior, but also designed to be commercially attractive to the intermediary by sufficiently low interest payments.

This treatment of interest rates is intended only for the narrow context of this discussion. At the national level there is increasing evidence that interest rates play extremely important and usually underestimated roles in resource mobilization, investment decision making, determination of the level of liquidity in the economy, and in the structure and role of the financial sector. However, problems of this nature do not commonly occupy the attention of the financial intermediary who must live within the constraints on the financial sector as he finds it. The competitive lender will be conscious of the use of interest rates both as a public relations tool in attracting rural depositors and as a revenue-producing tool in asset management and budgeting. Net earnings from interest and other income can provide resources for reinvestment in the intermediary's business, which can expand effective rural access to financial services, often by expanding the range of services available. This means, in effect, expanding the financial choices of the target group. It is interesting to note that financial intermediaries in highly developed economies devote a large part of their competitive activities to devising more convenient services for customers rather than engaging in direct interest rate competition.

In most countries checking accounts earn no interest and may even be subject to modest service charges.

Perspective and Implications

For rural developers and others concerned with rural welfare in developing countries, perhaps the most important philosophical implication of the argument presented here is that it is not very helpful to view rural people as financial basket cases, as merely "poor". Rather, it is obvious that rural people do save, and that the development challenge lies in the design of financial technology to serve the savings needs of rural people. Which packages of financial services will permit more effective rural access to formal institutional financial markets? Rural people and rural savings should be seen as a marketing challenge. Success in institutionalizing rural working balances will be achieved by rural developers where they can design financial services that rural people find more beneficial than whatever alternatives presently exist.

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Note: Views expressed in this article are the author's, and are not attributable to the World Bank.

Mobilizing Household Savings Through Rural Financial Markets

Dale W. Adams

[Rural household savings have been generally neglected in financial policy making, and in discussions of rural development. Reasons why they should be encouraged, and ways in which this could be done, are outlined.]

There is general agreement that in early stages of development most low-income countries must rely heavily on agriculture in seeking capital for their economies. Much less agreement is found on questions about the magnitudes of agricultural savings capacity and on how surpluses can be mobilized most efficiently. Only a handful of countries have stressed mobilization of voluntary household savings through rural financial markets. In part, policymakers have ignored these savings because of widely held assumptions about rural household saving behavior. It has been assumed that these household are too poor to save, and that those which do acquire additional income spend the windfalls on consumption or ceremonial sprees. It will be argued that these assumptions are incorrect, that substantial voluntary rural household savings capacities exist, but that household savings are strongly influenced by rural financial markets which have generally tended to discourage rural savers.

Household Savings Decisions

Relatively little is known about rural household savings in low-income countries. Exacting data

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requirements, the large number of heterogeneous decision-making units involved, the complexity of the household decision-making process, and inadequate theoretical models of household saving behavior have hindered analysis. In most studies of national savings problems household savings are ignored, and emphasis is placed on government, corporate, and aggregate savings performances. Nevertheless, household savings generally make up the largest part of aggregate savings in market-oriented economies; an ECAFE study of seven countries in Asia, for example, showed that household savings made up one-half to two-thirds of total savings. Several economists--e. g. Ronald I. McKinnon, Edward S. Shaw, U. Tan Wai, Hugh T. Patrick--have argued that household savings as well as aggregate savings are closely related to financial market policies. They argue that financial markets influence the forms in which savings are expressed, as well as the total amount of potential consumption which is diverted to savings. This influence can be better understood after the various dimensions of the rural household decision-making processes are clarified.

A large number of studies have been done on farmers' production activities and on rural household consumption and household investment-savings activities. In most cases, however, the farm-firm (i. e. the farm treated as a business firm of producers) and the consuming household are studied independently. Only a few researchers have attempted to develop an integrated model of the farm-firm and the household. An integrated model must include at least three interrelated sets of activities: production, consumption, and savings-investment. The production activities may be carried out within the farm-firm but also in some nonfarm enterprise owned by the household, or within the household itself. Some of the inputs which go into these production activities may be supplied directly by the household; others may be purchased with the household's own financial resources, while still others might be purchased with borrowed money or received through barter. In addition, income earned by household members from the outside may go into farm investments (as well as into consumption). The selection of a particular production activity and associated inputs will largely depend on the resource endowment of the firm-household and potential profits.

A complex set of consumption activities takes place simultaneously. Some of the goods consumed may be drawn directly from the farm production. Additional goods may be purchased with owned or borrowed money, while still other consumption goods may be received in exchange for products or services. Some benefits such as education, health expenditures, and acquisition of consumer durables will be realized by the household over several time periods: there may be a savings-investment component. Overall, consumption is limited by the amount of income generated by the farm production and other earnings listed above, plus savings accumulation and borrowing potential.

The firm-household's savings-investment activities may be fewer in number, but more complex than either production or consumption activities. The complexity is due to the uncertainties associated with the stream of future income expected from possible activities: investments in durable inputs such as land, land improvements, irrigation facilities, tractors, livestock, and buildings; savings directed toward expanding operating expenses of the firm; and investments made in nonfarm activities. Savings can also be expressed in various types of financial forms or nonproductive assets. The exact makeup of the asset portfolio held by the household will depend on household preferences, the security, liquidity, and availability of particular forms of saving, and their expected net rates of return.

The dimensions of the firm-household decision-making process are easy to specify, but the interactions between the various dimensions over time are difficult to quantify when a number of changes are occurring together. For example, the effects on household decisions of a real increase in interest rates paid on financial savings are hard to sort out when household incomes move up and down, rates of return on various activities may be jumping around, and attractive new consumption goods may become available to the household. In addition, the makeup of the household may be changing substantially. Casual relationships between some elements in the various dimensions may run two ways: for example, increases in household income cause some increase in consumption, while at the same time the availability of new attractive consumer durables such as refrigerators, motorbikes, radios, and television sets may induce a household to work longer hours to generate the income to purchase the same (a process which involves both increases and decreases in savings). Despite these messy methodological problems, one would expect to find a close inverse relationship, other things being equal, between the average rates of return the household expects to receive from its savings and the proportion of income allocated to consumption.

Role of Rural Financial Markets

Rural financial markets may influence household behavior in several ways. On the one hand, they may augment the household's liquidity pool by providing access to credit. This additional liquidity allows the firm-household to use more inputs in production and may increase the net income of the household from these activities. This increased income expands the household's savings capacity. The additional liquidity also allows households to maintain consumption which would otherwise be disturbed by uneven income flows. Credit further allows households to make costly purchases of con-

sumer durables and large productive capital goods. When negative real rates of interest are charged on loans, the household may also receive an income transfer through the borrowing process.

On the other hand, rural financial markets may stimulate households to save more by offering various types of financial savings instruments: if these instruments provide positive real returns to the household, they may induce the household to convert some of its excess liquidity into financial savings. The rate of return realized by the household on its savings portfolio may then induce the household to divert still more of its income to savings.

Evidence on Rural Savings Capacities

At this point, two major questions might be raised. The first is, do rural households in low-income countries have a significant savings capacity? Although sketchy and scattered, some data are available to answer this question. Findings on average propensities to save of rural households in five countries are shown, and more information on rural savings behavior from a few other countries is summarized. The second question is, how strong is the relationship between the rates of return expected on various kinds of savings, especially on financial savings, and the consumption decisions in the household? Unfortunately, there is little hard evidence available on these relationships, although some findings are suggestive.

Taiwan Evidence. Recently completed studies in Taiwan provide a review of rural savings capacities during the past decade and a half. Three factors make these data useful. First, high quality, detailed information is available on rural firm-household earnings and expenditures. Second, analysis is facilitated by significant changes in income and consumption among rural households over the past several decades. Third, Taiwan has promoted a voluntary savings mobilization program which included major interest-rate adjustments. Over the period 1953-1970, the real rates of interest paid on time deposits were negative in only 2 years, 1953 and 1960 (that is, the nominal interest rate paid on deposits was less than the rate of inflation). Savers could expect to receive a positive real rate of return on their time deposits of about 5-6% over most of the 1953-1970 period. From 1954 to 1970, the value of financial deposits in farmers' associations increased from the equivalent of less than US$6 million to over US$124 million. The deposits in the associations at times exceeded the value of loans made to association members, so that funds were transferred to other parts of the economy through financial channels.

The average propensities to save (APS) shown in Table 1 are drawn from very reliable data collected by a farm record-keeping project in Taiwan. (The APS is defined as the ratio formed by subtracting the total annual value of household consumption from total net household income, and dividing this savings value by total income.) The households included in the project have incomes and farm sizes somewhat larger than the average Taiwanese farmer, though they are small farmers by the standards of most other countries. However, any upward bias in APS was offset by defining purchases of all consumer durables, and expenditures on health and education, as current consumption rather than investment. The APS for all households ranged from 0.19 to 0.31 over the 1960-74 period. The APSs among even the smallest farm size groups were large. Additional analysis of these farm records indicated that savings were related to changes in the rates of return on farm assets: households saved more when they had profitable investment possibilities.

TABLE 1

APS OF FARM RECORD-KEEPING HOUSEHOLDS IN TAIWAN BY FARM SIZE GROUPS, 1960–74*

Farm Size Groups	1960	1962	1964	1966	1968	1970	1971	1972	1973	1974
.5 hectares or less†	−.03	.09	.09	.19	.19	.15	.08	.19	.21	.17
.5–1.0 hectares	.15	.17	.22	.16	.23	.14	.16	.16	.23	.26
1.0–1.5 hectares	.14	.20	.27	.25	.25	.20	.23	.16	.27	.31
2.0 hectares or more	.27	.25	.29	.38	.36	.26	.24	.32	.28	.39
Average all households	.19	.21	.23	.28	.28	.20	.19	.23	.27	.31
Total no. of households	95	233	535	430	416	404	347	452	460	461

SOURCE.—Department of Agriculture and Forestry, Provincial Government of Taiwan, *Report of Farm Record-Keeping Families in Taiwan*, various years 1960-74 (Nantou: Department of Agriculture and Forestry, Provincial Government of Taiwan).

* The APS is equal to one minus the ratio of total household consumption/total net household income.

† One hectare equals 2.47 acres.

Japanese Evidence. Although no longer a low-income country, Japan's rural household data do provide additional insights into savings behavior of small farm households. Since the early 1920s, agricultural cooperatives in Japan have mobilized financial savings well in excess of the amount of agricultural loans extended by the cooperatives. A large part of these excess funds moved out of the rural sector through financial markets. The APSs shown in Table 2 were calculated from postwar data collected annually by the Japanese Farm Household Economy Survey. Because of the surveying techniques used, household income is probably underreported and the ratios are, therefore, conservative estimates of actual household savings capacities. APSs for the average household from 1950 to 1973 ranged

from 0.10 to 0.22. After 1960, the savings of households with very small farms increased even more markedly than other groups, in part because of the rapid increase in household income from off-farm sources. Other household studies of rural consumption-savings in Japan confirm the APSs given in Table 2. Without exception, these studies show that rural households in Japan have had high average, as well as marginal, propensities to save, and that incentives played an important role in stimulating these savings.

TABLE 2

APS OF FAMILIES IN THE JAPANESE FARM HOUSEHOLD ECONOMY SURVEYS BY FARM SIZE GROUPS, 1950–73*

Farm Size Groups	1950	1955	1960	1965	1970	1971	1972	1973
.5 cho or less†	.04	.07	.10	.14	.16	.17	.19	.23
.5–1.0 cho	.07	.08	.08	.14	.14	.15	.18	.19
1.0–1.5 cho	.10	.12	.11	.16	.14	.12	.19	.21
1.5–2.0 cho	.13	.14	.13	.20	.14	.12	.16	.21
2.0 cho or more	.16	.15	.17	.24	.19	.13	.24	.23
Average all households	.10	.10	.11	.16	.15	.15	.19	.22
Total no. of households	5,306	5,666	5,781	17,002	10,460	10,307	10,380	10,439

SOURCE.--Ministry of Agriculture and Forestry, *Farm Household Economy Survey*, vol. 1, 1974; and *Annual Report for Farm Household Economy Survey* (1973), Ministry of Agriculture and Forestry, Tokyo, 1975 (in Japanese).

* The APS equals total disposable income minus gross household expenditures, including depreciation on households capital goods divided by total disposable income.

† One cho is equal to approximately one hectare or 2.47 acres.

Korean Evidence. In September 1965, the South Korean Monetary Board approximately doubled the rates of interest applied to loans and time deposits. Nominal interest rates on time deposits were raised to 30%. As a result, real rates of interest in excess of 8% were paid on financial savings from 1965 to 1971. This financial reform resulted in large increases in financial savings: total time and savings deposits in all banks jumped from only 39 billion in 1964 to 366 billion won in 1968. Financial deposits in agricultural cooperatives increased at about the same rate, and the number of savings accounts also increased sharply during this period.

Rural household savings behavior in South Korea has not been analyzed in detail, but some interesting information is available. The data in Table 3 were drawn from annual farm household surveys carried out by the Ministry of Agriculture and Fisheries. The average APS for all households ranged from 0.04 in 1965 to 0.33 in 1974. As in the Taiwanese and Japanese data, APSs among households with small farms were surprisingly large. It is particularly noteworthy that APSs increased substantially from 1965 to 1974. Part of this increase was undoubtedly due to expanded incomes and to farm policies which increased the returns to on-farm investments, while part was due to the more attractive incentives provided by financial markets.

TABLE 3

APS OF FAMILIES IN KOREAN FARM HOUSEHOLD ECONOMY SURVEY BY FARM SIZE GROUPS, 1962–74*

Farm Size Groups	1962	1965	1966	1968	1970	1971	1972	1973	1974
.5 cheongbo or less†	.05	−.05	.01	.06	.03	.17	.02	.15	.22
.5–1.0 cheongbo	.12	.01	.09	.11	.13	.24	.21	.19	.29
1.0–1.5 cheongbo	.16	.06	.10	.20	.16	.34	.34	.27	.35
1.5–2.0 cheongbo	.15	.12	.13	.23	.26	.35	.30	.34	.43
2.0 cheongbo or more	.22	.13	.23	.24	.19	.47	.30	.40	.40
Average all households	.15	.04	.11	.16	.15	.29	.24	.26	.33
Total no. of households	1,163	1,172	1,180	1,181	1,180	1,180	1,182	1,170	2,515

SOURCE.—Ministry of Agriculture and Fisheries, Republic of Korea, *Report of the Results of Farm Household Economy Survey* various years 1962–75, published yearly by the Ministry of Agriculture and Fisheries, Seoul.

* The APS equals total farm household net surplus/total net disposable income.

† One cheongbo equals 0.992 hectares or 2.45 acres.

Malaysian Evidence. A cross-sectional study of household savings activities in the mid-1960s in West Malaysia provides some additional evidence on rural savings capacities. Approximately 60% of the 5,147 households surveyed were in rural areas. Although the survey techniques used probably resulted in underreporting of incomes, the APSs shown in Table 4 suggest that significant savings capacity exists among the surveyed rural households, and that APSs increase rapidly among farm operators and fishermen as their incomes increase.

TABLE 4

RURAL HOUSEHOLD SAVINGS (APS)* IN WEST MALAYSIA BY OCCUPATION AND INCOME LEVEL GROUPS

	Occupational Groups			
Annual Income Groups	Farm Operators and Fishermen	Rural Employees	Mixed Operators and Employees	Rural Businessmen
Less than $3,000†	.01	.07	.08	.06
$3001–$10,000	.12	.06	.43	.16
More than $10,000	.46	...	...	...
All income groups	.06	.07	.12	.13
Total no. of households	1433	1433	87	84

SOURCE.—Lee Hock Lock, *Household Saving in West Malaysia and the Problem of Financing Economic Development*, Monograph Series on Malaysian Economic Affairs (Kuala Lumpur: Faculty of Economics and Administration, University of Malaya, 1971), pp. 54–57.

* Total household savings divided by total household net income.

† Expressed in Malaysian dollars. In 1970, M$3.09 = U.S.$1.00.

Indian Evidence. A large number of the studies on rural savings have been done in India. In general, they show smaller savings capacities than noted for Taiwan, Japan, and Korea. This is due, in part, to lower per capita incomes in rural areas of India. One might also

argue that rural people in India have less incentives to save: on-farm investments in many areas yield low returns, and badly fragmented financial markets do not offer savers positive real rates of return. Nevertheless, information from studies in Punjab State show that savings capacities rapidly expanded there during the late 1960s. Table 5 gives APSs for a group of 180 farm households in two districts of the Punjab for four crop years, 1966-70. These are prosperous areas which benefited substantially from changes in agricultural technology during the 1960s. The average household saved or invested 12%-37% of its income. In some years, savings capacities among even the smallest farm size groups were quite high. On the basis of household level studies in another state of India, Desai and Desai found very substantial savings in households experiencing income increases: they report marginal propensities to save of .29 and .63 for two groups of rural households.

TABLE 5

APS OF 180 FARM HOUSEHOLDS IN TWO DISTRICTS OF PUNJAB BY FARM SIZE GROUPS, 1966-67 THROUGH 1969-70*

	Ludhiana District				Hissar District			
Farm Size†	1966-67	1967-68	1968-69	1969-70	1966-67	1967-68	1968-69	1969-70
Small	.02	.06	.06	.17	.01	.09	.34	.34
Medium	.17	.23	.30	.26	.21	.21	.38	.36
Large	.18	.22	.28	.25	.09	.17	.37	.31
Average	.14	.20	.25	.24	.12	.18	.37	.34
Total no. of households	72	72	72	72	108	108	108	108

SOURCE.—A. S. Kahlon and Harbhajan Singh Bal, "Factors Associated with Farm and Farm Family Investment Pattern in Ludhiana (Punjab) and Hissar (Haryana) Districts, 1966-67 through 1969-70," unpublished report (Ludhiana: Department of Economics and Sociology, Punjab Agricultural University, n.d. [ca. 1971]), p. 116.

* APS is the ratio of net farm family savings and net farm family income.

† In Ludhiana, small units had less than 3.5 hectares, medium-sized units 3.5 to 6.0 hectares, and large units more than 6 hectares. In Hissar, small units had less than 4 hectares, medium-sized units 4 to 8 hectares, and large units more than 8 hectares. One hectare equals 2.47 acres.

Other Evidence. Bits and pieces of information from a handful of other countries support the conclusion that significant amounts of voluntary savings capacity exist in rural areas of low-income countries. During the latter part of the 1960s, for example, the University of Nottingham did intensive case studies of 239 households in Zambia over a 2-year period; detailed accounts were kept on their economic activities. On the average, these accounts showed that the rural households included in the study were saving more than 30% of their income. Several years ago, coffee cooperatives in Kenya began to deposit members' receipts from sales of coffee in unblocked savings accounts. The leaders of the cooperatives have been very surprised by the large amounts which have been left on deposit for long periods. Recently, deposits in these cooperatives substantially exceeded the volume of

funds lent by the cooperatives. Success in developing rural savings clubs in Zambia, Lesotho, Rhodesia, and Malawi and mobilization of savings through postal savings, savings banks, and credit-savings unions in many parts of Africa provide further evidence on rural savings capacities. A recent study of household consumption-savings in a rural area of Ethiopia showed APSs ranging from 0.11 to 0.14. The author of this study stresses that these are conservative estimates of savings since household incomes in the study were likely under-reported.

Advantages from Mobilization of Voluntary Rural Savings

At this point, a skeptic might argue that, even if some voluntary savings capacities do exist in rural areas, they are too costly to mobilize via financial markets and that other resource mobilization techniques are more efficient. There are at least three strong reasons for stressing voluntary rural financial savings. The first reason is that they may be important to overall strengthening of the financial markets. Until recently, most economists assumed that financial markets played a neutral or minor role in development but this view has been challenged, as noted earlier.

A second reason is that mobilization of financial savings could play an important part in strengthening local farm credit and service organizations. For a number of years many less developed countries have tried to bridge the "institution gap" in rural areas between national service organizations and the individual farmer by building cooperatives and farmers associations. Despite some modest success in a few countries, the experience with building these intermediate credit organizations has been disappointing. Typically, their loans are offered to members at low rates of interest. These rates are almost always below the opportunity costs of capital in the economy, below the going commercial rate of interest in the money market, and often well below the rate of inflation. These concessional interest rates weaken the intermediate organization in several ways. Low interest rates force intermediate organizations to ration their "bargain credit", and these nonmarket rationing decisions are highly vulnerable to various types of personal influence, political persuasion, and outright corruption. In addition, concessional interest rates on credit almost always force an intermediate organization to concentrate its loans in the hands of relatively few borrowers in order to minimize lending costs. The lament that the large farmer captures most of the concessionally priced cooperative credit can be heard around the world. Further, low interest rates which do not cover the costs of lending make it next to impossible for intermediate organizations to maintain, let alone expand, the real value of loanable funds. This problem is exacerbated by the capital erosion caused by

inflation, and also by the inability of credit organizations to offer sufficient interest-rate incentives to induce members to deposit funds voluntarily in their organization. Cooperatives and farmers associations are forced to live the uncertain life of a beggar, whose sustenance must come from beneficient central banks or foreign aid agencies. However, a mobilization of voluntary savings could allow these intermediate organizations to develop a much larger degree of independence and self-sufficiency.

A third major reason for mobilizing financial savings is the favorable impact it can have in discouraging household consumption. The incentives to save provided by financial markets can be strong inducements for households to defer consumption. But it is little wonder that financial institutions in rural areas of Colombia, Bangladesh, the Philippines, Kenya, and Ethiopia, for example, attract very few savings deposits when they offer negative real rates of interest on deposits. These rates encourage, rather than discourage, consumption expenditures, thus reducing capital formation.

A Savings Mobilization Strategy

If financial markets are to play a positive role in the resolution of rural poverty, fundamental changes in policies in most low-income countries will be necessary. Current policies are resulting in badly fragmented financial markets, in concentration of concessionally priced credit in the hands of relatively few people, in unprofitable financial operations in many rural cooperatives, and in little or no incentive for rural households to defer consumption. Overall, these financial policies are very regressive: the relatively well-off benefit from the concessionally priced credit, and the poor are denied access to production credit as well as remunerative savings instruments. Furthermore, there is too little honest competition between formal financial markets and informal money lenders. Under these conditions, some informal credit sources are able to continue to extract monopoly profits from small borrowers who are denied access to formal markets. A rationalization of financial market policies, combined with aggressive savings mobilization programs, would eliminate many of these undesirable features.

A savings mobilization effort should be carried out at two levels. Some changes must be made at a national level before substantial voluntary savings can be mobilized. In general, these changes include a more flexible interest-rate structure. Where rates of inflation are above 15%-20% per year, savings instruments might be value linked so that the value of the savings principal is tied to price changes. Additional inducements might include tax exemptions on

interest payments made on certain kinds of savings deposits. It is often necessary to institute legal changes so that cooperatives and other local organizations legally can handle credit and savings activities. In some cases it might also be necessary to adjust some laws and administrative procedures so that local organizations can be integrated into regular financial markets. Bonding services for employees who handle financial activities would also be helpful. In addition, nationwide deposit insurance programs such as those found in the United States, the Philippines, and Uganda are needed to assure savers of secure deposits.

At this point, a reader might comment that raising interest rates is great in theory but politically impossible to carry out. Some politicians view concessionally priced credit as a way of buying political support. However, cheap credit policies lead to cheap savings policies; and only those who receive concessionally priced credit benefit. More votes could be positively influenced by high rates of return on savings deposits which will make possible a wider availability of credit, than will be bought by concessionally priced credit which is given to only a few.

Where some of the above-mentioned conditions are present, savings mobilization programs can be initiated. Fortunately, many of the less developed countries have at least a partial set of institutions already in place which can handle rural financial savings. In many countries, including the Dominican Republic, Costa Rica, the Philippines, India, and Bangladesh, a number of banks already provide financial services in many rural areas; postal savings offices, cooperatives which handle credit, and credit-savings unions are found in other parts of the less developed world. A local savings mobilization effort, therefore, need not construct new financial institutions in such areas. Initially, major emphasis should be placed on getting a balanced and economically sound set of financial activities in the institutions which already exist.

The exact makeup of savings mobilization programs will vary from area to area. In some cases, various types of forced savings programs may be appropriate: required share purchases in an organization, compensatory balances, regular contractual savings, and even depositing cash receipts in an unblocked savings account may be devices stressed in the start-up phase of a savings mobilization program. The mobilization effort, however should begin early to stress voluntary savings incentives. The Taiwan, Korean, and Japanese experiences suggest that voluntary savings should make up the bulk of the savings mobilized. The key element in a voluntary mobilization program is the attractiveness of the reward paid on savings, along with the convenience, liquidity, and security of the savings. In addition, lottery schemes could be attached to

savings deposits to promote interest in voluntary savings: a number of countries, including Egypt, Sweden, Tunisia, Colombia, Russia, El Salvador, Iran, France, and India have some type of lottery prize associated with savings accounts. In a few cases, a life insurance option tied to savings deposits will also strengthen the incentive to save; this has been a popular feature in some credit-savings cooperatives in Latin America.

Any savings mobilization effort will work better where rapid agricultural growth and increasing rural incomes are occurring. A national savings program should, therefore, initially stress savings promotion in areas where agriculture is on the move. Above all, regardless of where the program is started, it should be strongly supported and promoted by government actions, and this includes rewards and recognition for successful organizations and managers.

In general, "development from below" appears to be the only way to reach the rural poor effectively. The savings program briefly outlined above might be a first step in a bootstrap approach to rural development in low-income countries. It would stimulate rural poor to increase their own capital base, it would provide a more healthy environment for local organizations to grow, and it would allow local financial institutions to integrate with national financial markets. Current financial market policies in most LDCs are an unmitigated disaster for most rural poor. It is past time for making policy adjustments so that rural poor are more fairly treated by this most important development instrument.

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Mobilizing Small Savings in India

N. K. Thingalaya

[This article describes the results of an Indian bank's efforts to attract small savings accounts by regular daily or weekly collections from savers, while making the operation pay its way. This bank's successes in deposit attraction should be of interest in other countries. The presentation is from a banking viewpoint.]

The Syndicate Bank, founded in 1925 in a small town in Karnataka State in India, has been a highly successful bank in terms of growth: it has nearly 800 branches around the country, some Rs 13.5 billion in deposits as of 1975, and ranks eighth among the large nationalized commercial banks. A major reason for its success has been a willingness to innovate; this article concerns one innovative method of attracting small savings deposits. [Note: The Development Digest of July 1978 had a more general article on this bank on p. 25; here we concentrate on the savings attraction aspect.]

For historical reasons, the size of a commercial bank in India is judged terms of its total deposits. When a number of banks big and small are competing with each other in mobilizing the savings of the society, the volume of deposits mobilized is construed as an index of the confidence the public has in a particular bank. Banks' financial resources, the volume of their loanable funds, and hence their scale of operations are governed by the success of their deposit mobilization efforts. Fixed deposits and savings bank deposits (as opposed to current or demand deposits, for checking accounts) constitute about 82 percent of the total bank deposits in India. These deposits originate mostly

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in the household sector: 58 percent of the fixed deposits and 97 percent of the savings bank deposits are contributed by individuals and professionals, while the deposits of the corporate and government sectors are less significant. The banks therefore woo the household sector by offering different types of savings schemes.

Except for minor variations in their operations, most savings schemes have much the same appeal to savers. Broad uniformities in the rates of interest offered by different banks are ensured through mutual consent under the aegis of the Indian Banks' Association, to avoid undesirable competition. However, the ingenuity of the banks in introducing innovative savings schemes is not completely curbed; some banks have been successful in breaking new grounds with their novel savings schemes. The "Pigmy deposit" is one scheme which has distinguished the Syndicate Bank from all other banks. This scheme was conceived as a supplementary source of resource mobilization, especially to bring in the small savers, along with the bank's other regular saving schemes.

The savings of the lower income groups are not generally tapped by any banking company because of the huge organizational task and the mediocre business prospects. (The non-banking financial intermediaries, which are not subjected to any monetary control, attract some savings of these groups by offering fabulous gift schemes.) As the savings would come in driblets, the cost of collection has to be kept down to render the savings scheme financially viable. It is therefore necessary to adopt a new strategy to serve these twin objectives.

The Pigmy Deposit

Under the Pigmy deposit scheme, the Bank arranges to collect small sums of money on a daily or weekly basis from the doorsteps of its prospective customers. The minimum amount of savings collected from the depositors under this deposit scheme is Rs 0.25 per day ($0.02). The collector, an accredited agent of the Bank, makes his daily rounds to collect the deposit from the customers. He issues a receipt to the depositor indicating the balance as of that day. The Pigmy Collector is not an employee of the Bank; he gets a commission on his total collections. The period of maturity for the deposit is 7 years. At the end of the seventh year, the depositor, saving daily Rs 0.25, is entitled to get Rs 700. The rate of interest offered is 3.13 percent. The attractiveness of the scheme is not this rate of interest, but the convenience of operation. The lower interest rate offered is justified on the ground that for small driblets of savings there are no other avenues to investment available, and so the opportunity cost is zero. The scheme contains a provision for con-

verting accumulated savings that come to over Rs 1000 into Pigmy Fixed Deposits, which fetch the higher rate of interest applicable to fixed deposits. This concession is a bait to lock up the savings for a longer period. A stringent penalty clause is also included in the rules of this scheme, making premature withdrawals very unattractive to the depositors. There has been virtually no change in the modus operandi of this scheme since its inception.

One distinctive advantage of this scheme is that, without going to the bank and doing the form-filling ritual, a small man like a village trader or a petty merchant could save either Rs 0.25 or multiples of that amount every day. This is possible because deposits are collected at the owner's house or place of work, daily or weekly, by the Pigmy Collectors. The amount of savings being very small, the contributors would not feel the pinch of foregoing the immediate use of their little money. Loans are also arranged on the outstanding balance of the Pigmy Deposit at times of need. After a few other public sector banks and some of the urban cooperative banks had started similar schemes, the Syndicate Bank introduced a new and more attractive variant called Adarsh Deposit Scheme in 1971. Under this scheme the duration is 5 years and the interest payable is 6 percent, as against 7 years and 3.13 percent in the Pigmy deposit scheme. Refunds are permitted after one year without interest, and if withdrawal is made after two years interest at the rate of 3 percent is given. As this revised scheme is more attractive than the Pigmy deposit scheme, there has been a perceptible shift toward it in the savers' preferences.

Growth in Pigmy Deposits

When the Pigmy deposit scheme was introduced on October 8, 1928, the total deposits held by the Syndicate Bank were only Rs 28,807. Since data on the composition of deposits are not available until 1946, it is not possible to assess the share of Pigmy deposits in the increase in deposits in the early years. The Pigmy deposits increased from Rs 4 million in 1946 to nearly Rs 477 million at the end of 1976. In 1946 when the total deposits of the Bank were only Rs 28 million, the Pigmy Deposits accounted for 14 percent of the total deposits, and during the 1950s they were 20 percent or more in most years. At present, however, these deposits constitute only 7 percent of the Bank's total: although they have increased very substantially in absolute terms, there was a more rapid growth in other types of deposits.

With the expansion of banking facilities and the spread of banking habits in postwar India, interest-consciousness among the depositors has become explicit. Their preferences now favor fixed deposits, and recurring or cumulative monthly deposit schemes where the rates of

interest are slightly higher. This phenomenon is found in the pattern of deposit growth of Syndicate Bank, as it is in the entire Indian banking industry as shown in the available banking data for the last three decades. The share of fixed deposits in the national deposit total has increased from 31 percent in 1946 to 52 percent in 1975. Savings bank deposits have also gained greater prominence in the composition of total bank deposits. The hike in the interest rate on savings bank deposits in 1953 has given a fillip to these deposits, and they now constitute about 25 percent of the total.

A similar huge increase in the conventional savings bank deposits has dwarfed the share of Pigmy deposits in the total deposits of Syndicate Bank. In 1949 both of them were almost at the same level: Pigmy deposits—Rs 6.60 million, and savings bank deposits--6.06 million. Their disparate growth rates are apparent in that the savings bank deposits reached Rs 1855 million in 1976, while Pigmy deposits were Rs 477 million. Similarly, the fixed deposits have increased from Rs 12 million to Rs 3198 million during the same period; their share is 51 percent.

The changing preferences of the savers could be attributed to the enhancements made from time to time in the rates of interest offered. The rate of interest on Pigmy deposits has been deliberately kept constant at 3.13 percent throughout with the objective of controlling the cost of raising funds through this scheme. In the case of the other deposits, interest rates are fixed by the monetary authorities and they have been varying along with the "bank rate". The rate of interest on savings bank deposits increased from 2.5 percent in the thirties to 4 percent in the sixties, and is 5 percent since 1974. The average rate of interest on fixed deposits increased from 5.5 percent in the thirties to around 10 percent at present. The Adarsh deposit, the younger cousin of Pigmy deposit, has better chances of acceptance by the interest-conscious depositors as it offers a 6 percent yield. But the cost of raising funds inevitably goes up.

The withdrawals of deposits on maturity--sometimes even earlier than maturity--are fairly heavy in the case of Pigmy deposits compared to other deposits. Unlike in the savings bank deposits, the withdrawals usually wipe out the whole amount accumulated in a single operation. The outstanding balances under this deposit scheme therefore tend to grow very slowly. During 1976 for example, the total collection of Pigmy and Adarsh deposits were Rs 374 million, while the net increase in the balance outstanding was only Rs 80 million, which raised the total Pigmy and Adarsh deposits from Rs 397 million to Rs 477 million.

Nevertheless, despite its smaller share in the total, the Pigmy deposit scheme continues to tap savings of the community which

could not otherwise be siphoned into organized banking channels. With an improvement in individuals' interest sensitivity--which is assumed to be low in less developed sectors of the economy--there is bound to be a shift in the demand for higher interest-bearing assets. And this transition is likely to assign a declining role to the deposits like the Pigmy in the future pattern of total deposits. The advantages of operating this scheme, however, are the relatively lower cost of raising the resources and the introduction of people to a banking habit who would not otherwise be reached.

Rural-Urban Composition

When the Pigmy deposit scheme was first formulated, the Syndicate Bank had only 2 branches--one rural and another semi-urban. Subsequently when the branch composition changed with the opening of branches in more urban centers, the Pigmy scheme was introduced in these branches. The data on the locations of Pigmy deposits from 1946 to 1976 reveal marked changes. In 1946, the number of branches was 73, and the total Pigmy deposit was Rs 4.02 million. The four metropolitan branches accounted for Rs 0.95 million of deposits as against Rs 0.30 million held by 26 rural branches. The share of the rural branches was around 7.5 percent until the late fifties. The more recent figures on the rural--urban composition of Pigmy deposits are presented in Table 1 (figures in parentheses are percentages).

The Pigmy deposits collected from the rural branches have grown from hardly Rs 2 million in 1960 to nearly Rs 50 million at the end of 1975. Consequently their share has increased from 5 to 12 percent. At the same time there has been a parallel development in the contribution of the metropolitan branches; their share has risen from 25 percent in 1960 to 29 percent in 1975. In the case of the semi-urban and urban branches, in the middle sized towns and cities which used to have 70 percent of the total, a relative decline is noted during the same period. The branches in the metropolitan centers evidently offer greater scope for the mobilization of Pigmy deposits than the rural branches. Wage-earners, doctors, hotel keepers and retail traders form the major market for Pigmy collections. The average amount of savings per Pigmy deposit account in rural areas is Rs 383, as against Rs 753 in urban areas. About 22 percent of the Pigmy deposit accounts originate from the rural areas.

The scheme originally formulated to tap the savings of rural and semi-urban areas now finds a better market in metropolitan areas and port towns. This adaptation has favorable financial implications to the Bank. The cost differentials in raising Pigmy deposits from rural versus urban branches--the cost being largely governed by the rate of commission--are negligible.

TABLE 1

GROWTH IN PIGMY DEPOSITS

(Rs.in Millions)

Branch classification	1960	1965	1970	1975
Rural	1.96 (5.03)	7.36 (7.86)	14.20 (9.20)	49.05 (12.35)
Semi-urban	14,52 (37.11)	32.10 (34.30)	50.16 (32.50)	121.15 (30.49)
Urban	12.96 (33.12)	30.98 (33.10)	45.68 (29.60)	110.42 (27.79)
Metropolitan	9.68 (24.74)	23.14 (24.74)	44.29 (28.70)	116.58 (29.37)
TOTAL	39.12 (100.00)	93.58 (100.00)	154.33 (100.00)	397.30 (100.00)

Note: The standardised population-wise classification of branches is as follows:

Rural	- Population upto 10,000
Semi-urban	- Population 10,000 to 0.10 million
Urban	- Population 0.10 million to 1 Million
Metropolitan	- Population above 1 million

The Small Depositors

The strategy adopted by the Syndicate Bank for deposit mobilization, as stated earlier, was oriented towards small savers. The Bank's continuing reliance on the small savers is shown by the fact that "small depositors", i. e. those with deposit accounts having an average balance up to Rs 1500, form over 80 percent of the total deposit accounts of Syndicate Bank. The Bank has nearly 6 million deposit accounts of which the "small" ones are 4.96 million. These deposit accounts include besides Pigmy deposits, savings bank deposits, cumulative and also fixed deposits. The number of these small accounts with the Bank has increased from less than 1 million accounts in 1965 to nearly 5 million accounts at present; this is

nearly proportional to the increase in numbers of larger accounts. The large number of small deposit accounts means a big clientele; but servicing these accounts becomes a labor-intensive operation. (The number of deposit accounts handled per employee works out to be 287 for Syndicate Bank, as against 120 for all public sector banks).

Cost of Raising Resources

An area in Indian banking in which practically no good data are available is the specific costing of various deposit schemes and the lending programs. In the absence of an elaborate cost-accounting system, a modest attempt has been made to estimate the costs of operating the various saving schemes of the Syndicate Bank; this is more an expedient estimate than a meticulous measurement. The cost of raising funds in 1975 through four types of savings schemes including the Pigmy Deposit scheme were calculated and appear in Table 2.

TABLE 2

OPERATING COSTS OF SYNDICATE BANK'S DEPOSIT SCHEMES

Type of Deposit	Cost of operation (% per annum on outstanding balance)	Cost Structure (Percentage)				
		Interest	Incentive/ Commission	Establishment cost	Others	Total
Current Deposits	0.20	-	-	60.00	40.00	100.00
Savings Bank	6.96	61.35	0.14	30.78	7.73	100.00
Fixed and Cumulative Deposits	13.01	90.08	0.15	8.62	1.15	100.00
Pigmy and Adarsh Deposits	5.52	8.48	70.05	20.11	1.36	100.00
ALL DEPOSITS	8.55	80.32	1.76	15.69	2.23	100.00

In estimating the cost of operation of the deposit schemes, all the costs incurred including the head office cost are taken into considera-

tion. The cost of raising Rs 100 of Pigmy deposits is Rs 5.52, as against the cost of Rs 6.96 for raising Rs 100 under savings bank deposits. After the recent upward revision of regulated deposit rates, fixed deposits have become a costlier deposit for the banks. The cost of raising Rs 100 of fixed deposits is now estimated at Rs 13 for Syndicate Bank. The cost of Pigmy deposit thus appears to be less than the cost of other deposit schemes in general (aside from current, or demand deposits, which are not really savings accumulations).

The structure of the costs of raising resources through various types of deposits reveals that the interest cost constitutes about 80 percent of the total cost; the establishment cost works out to about 16 percent. The frequency of operations in the case of current deposits and savings bank deposits being higher, the establishment costs constitute a sizeable percentage of the total. Though no commissions are paid for canvassing savings bank and cumulative deposits, some monetary incentives are provided to the staff through annual competitions. In the case of Pigmy deposits, however, the interest component is of a lower magnitude, while the commission paid to the Pigmy Collectors accounts for 70 percent of the total cost.

Another cost element, of a lower magnitude, is the premium paid on the deposits to the Deposit Insurance Corporation, which has been set up in 1962 under an Act of the Parliament. The insurance cover provided by the Corporation has extended from Rs 1500 per depositor in the initial years to Rs 20,000 at present. The premium charged was 0.05 percent per annum till recently, and at present it is 0.04 percent per annum. The Syndicate Bank has about 97 percent of its deposit accounts in the covered group of less than Rs 20,000; its premium was Rs 1.69 million in 1975 and Rs 2.18 million in 1976.

Rise in the cost of operation of all banking services is almost a universal phenomenon in recent years. However, the non-availability of cost data relating to the earlier years discourages any attempt to assess the extent of escalation in the cost of operation of Pigmy deposits since its inception. What little could be done here, confined to one decade, is inevitably based on surrogates for some of the major cost items.

The upward revisions made in the salary structure between 1965 and 1975, and the higher interest rates stipulated by the monetary authorities with a view to encouraging domestic savings, have both contributed largely to a fast rise in the cost of bank funds. The salary structure of the banking industry is periodically revised upwards on the basis of the agreements reached with the staff unions. The establishment cost has therefore been increasing as the major component of the cost of raising funds. The printing and stationery

expenses also have been on the increase, largely attributable to the rise in prices. A composite cost index was derived with 1965, the first year, as the base. The number of deposit accounts is used as a deflator to measure change in the cost per account. Similarly, the value of deposits is used as a deflator to obtain changes in the cost of raising a Rupee of deposits. The weighted arithmetic means of the composite cost indices for Pigmy deposit scheme and for all deposit schemes in the Bank are presented in Table 3.

TABLE 3

COST INDICES OF PIGMY DEPOSITS AND ALL DEPOSITS

Year	Pigmy Deposit (Deflated by No. of Accounts)	All Deposits (Deflated by No. of Accounts)	Pigmy Deposit (Deflated by Amount)	All Deposits (Deflated by Amount)
1965	100	100	100	100
1970	153	161	207	126
1975	259	301	332	181

The cost index of a Pigmy deposit account appears to have risen more than two and a half times during the last decade, while the cost index for all deposit accounts increased by a higher magnitude. When the total value of deposits is used as the deflator, however, the cost indices show a quite different result: the cost index of Pigmy deposit would appear to be increasing considerably faster than the cost index of all deposit schemes. This occurs because during the period the value of Pigmy deposits increased by four times while there was a nine-fold increase in the value of total deposits, and the value of the average account rose more slowly in the Pigmy group than elsewhere.

Among cost elements, the commission paid to the Pigmy collectors is the single largest component. For many years the rate of commission was kept constant: from 1928 to 1962, the commission was 1.5 percent of the deposits collected. When staff members were legally precluded from doing the Pigmy collection work, the commission paid to the full time commission agents was raised to 2 percent in 1963, and to 2.5 in 1971. The rate of interest paid to the Pigmy depositors has been maintained at 3.13 percent since the inception of the scheme. Only after the competition from other banks through imitation was found to be growing, the Bank raised the rate of interest on a new variant of Pigmy deposit--the Adarsh deposit--to 6 percent in 1971. The cost

of the Pigmy deposit would be escalated, in effect, if an increasing portion of the same is withdrawn before maturity. Usually, however, the branch managers dissuade Pigmy depositors from withdrawing their deposit before maturity. Instead, they are encouraged to borrow against the security of their deposits.

Some Inferences

The Pigmy deposit scheme has enabled its innovator-bank to raise resources, especially in the earlier years of the Bank's growth. Along with the other commonly adopted schemes of deposit mobilization, this scheme has been employed to tap the savings of a particular group of relatively new customers. Its efficacy as a resource-raiser could be judged by the relative costs of raising resources compared to other schemes. Because of its low cost, this scheme could be of interest to other less developed countries where the banking sector and the financial institutions have yet to gain a strong base. Further, the Pigmy deposit scheme could also be of interest as a method of inculcating banking habits among those classes of society that normally remain beyond the ambit of modern banking. The itinerant bank agent would perhaps be more easily acceptable to them than the requirement to perform the formfilling rituals at bank branch counters.

The cost of raising resources through this scheme would be somewhat lower if the commission and the rate of interest paid were kept constant or were relatively slow to increase in an environment of inflation. The diminutive size of the daily savings would not fetch any appreciable interest until they accumulate over a period, at which point they could be converted into another form of deposit. The very fact that this scheme is equally or more popular with the presumably interest-rate conscious small savers in metropolitan and urban centers than with the more interest-insensitive rural depositors suggests that the interest rate differential does not greatly impede acceptance of this scheme. This observation is strengthened by the practice of some medium size traders and hoteliers who contribute fairly large sums like Rs 100 per day as Pigmy deposits. The scope for deposit mobilization is not unlimited, of course, but it does seem that a new and not insignificant source of savings has been opened up by the method. However, it must be remembered that low cost is one of the key elements in success, and that the rate of commission paid to the collectors is the crucial factor in determining the cost of funds.

The Pigmy savings scheme seems to have a better mass appeal, given the necessary publicity support, during the early stages of banking development than it does later. Premature withdrawals,

and the faster growth of higher-interest-yielding deposits, may be construed as the symptoms of shrinkage in the popularity of Pigmy; they also represent changing market conditions. The improved version of Pigmy introduced later, in response to the market stimuli, should have better prospects. Designed as it is to attract small savings, this scheme cannot be expected to immediately bring in larger resources than methods of attracting resources from the rich, but it enables a financial institution to reach a larger clientele with growth potential.

[Extracted from Chapter 2 of Innovations in Banking: The Syndicate's Experience, pp. 9-30. Domestic Finance Studies No. 46 of the Development Economics Department, Development Policy Staff of the World Bank, January 1978.]

Traditional Capital Formation in African Agriculture

John F. S. Levi

[This article considers factors that affect the creation of the kinds of rural capital that do not rely on financial institutions, and some ways in which such capital formation might be encouraged. Rather little has been written on this subject; the article supplies an exploratory approach.]

This article may seem rather heretical, for it deemphasizes the importance usually given to financial savings and credit in rural development. It is concerned with the physical capital formation that actually occurs in rural Africa, with or without external assistance. Much, and perhaps most of such capital formation is brought about by the direct application of unpaid family labor; and if money is needed it comes more from family or neighborhood sources than from formal financial institutions. Very little attention has been paid by those concerned with rural development to traditional investment, perhaps because it usually appears somewhat crude or backward and does not give the impression that it might be capable of generating much improvement in rural living standards. (There are exceptions to this; in particular, there is the traditional investment in "economic trees", such as cocoa and coffee, which has long been seen as remarkable in the growth it has given rise to in many African countries.) The major types of capital created by traditional forms of investment are: livestock, including draught animals; plows and other cultivating equipment; land improvements such as terracing, tree-stump removal, etc; water control and irrigation works, such as bunding, drainage, irrigation channels, ponds, wells, etc.; structures, such as fences and buildings.

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Instances and Determinants of Traditional Productive Investment

Some instances of traditional productive capital are remarkable by any standards. One such is the irrigation system constructed by the Chagga in northern Tanzania, and described by W. Allan. "The construction of the furrow system through which water is distributed to homesteads throughout the mountain, over many miles of difficult country, represents an engineering feat of no mean order, and the successful operation of the delicate machinery required to maintain the works and to administer rights and easements must be regarded as a social achievement no less remarkable. Users of furrows formed what was, in effect, a Waters Users Association which met to decide on the equitable division of water and to arrange a program of maintenance by communal effort." The rights and duties of the "owners" of the different segments of the system--canals, furrows, springs, streams and ponds--were carefully balanced and rights could be lost on failure in duty, while a pecking order of water use was maintained, modified by urgency of need and discussion of special cases.

In other cases investment, though indigenous, has received encouragement from outside. An example, little less remarkable than the previous one, is the terracing found in the Kigezi highlands of Uganda. This is found in areas that were settled in the 1940s and as the result of a deliberate attempt by the colonial government to stave off the effects of rising population pressure. Unfortunately, the temporary palliative it provided was not followed up by further measures, and twenty years later the region was evidently back in the same position of land being worked to its limits.

Often, traditional investment takes place as a spontaneous response to rising population, in that capital is created to substitute for land which is becoming scarcer. It is worth noting that this response leaves no room for complacency, for it generally appears to barely keep pace with population growth, or not even that. An example of these circumstances is found in the highlands of Guinea. The farmers concerned formerly practiced shifting cultivation, but the steeply sloping land has meant erosion. Permanent cultivation of manured and composted land is therefore tending to increase. This type of cultivation needs fences to keep animals off the crops, and wooden fences are the most flexible for expanding the cultivated area, but they have to be renewed now and again because of termite damage, and fencing wood is becoming more and more scarce and distant. The alternative is the earth wall, which is more durable but less flexible for field extension and entails a much larger labor investment. Intensification and investment may be not only a response to population growth as such, but also to the confinement of people within a smaller region than they would like because of the hostility of other people. The classic case of Ukara Island in Lake Victoria is often pointed to in this regard, as is the abandonment

of intensive systems for more extensive ones on the return of peaceful conditions.

In other cases capital formation may arise as a result of quite a different type of constraint on labor. Allan mentions the drainage channels and canals maintained by serfs of the Lozi in Central Barotseland, Zambia. After serfdom was abolished, the drains could apparently not be kept open and much of the land reverted to marsh; plowing was introduced later in an attempt to offset the reduced labor supply, and a further response was emigration in the 1940s.

Costs and Returns

Estimated rates of return on rural investment are rare, and in any case present conceptual problems. Clues as to the effect on productivity may be got from two studies: Massell and Johnson on Rhodesia, and Heyer on Kenya. The latter found considerable variation in crop outputs which was not explained by the inputs of adult hours of work and acres of land. She arbitrarily calls the unexplained residual "management", while admitting that there are other unquantified factors at work. Some of these are capital: in particular stores, fencing, soil conservation works, plows and oxen (not all the 16 farmers possessed plows, and some shared). "Variations in managerial skills led to better farmers being able to make about four times as much as poorer farmers with the same labor and land resources. . . "

In the Darwin Purchase Area of Rhodesia, Massell and Johnson found that a considerable amount of labor during the slack season was being devoted to contouring, ridging, building dams, etc. They attempted to estimate a statistical production function which did not include any variable reflecting the variation in this kind of labor-produced capital, but which did include purchased capital equipment. Like Heyer, they attributed to "management" any variation in output not attributable to the inputs included in their production function, but admitted that it could be due to land improvement, selection of seeds or use of pesticides. The effect on output of these "residual" factors was quite significant: ". . . the best farm could, with given inputs [i. e. those measured and included], obtain just twice as much output as the worst farm. "

In Sierra Leone, rain-fed upland rice, using fire-fallow, is the most important crop, but permanently cultivated swamps are gradually increasing in extent as population grows and fallow periods shorten. Yields are generally higher in swamp cultivation than in upland, but the labor required per acre is greater. Is the extra

yield worth the extra effort and the initial investment of labor in clearing, levelling and bunding the swamp? The 1970/71 Agricultural Survey gave estimated yields of .63 tons (1,411 lbs) per acre from inland swamps and .53 tons (1,189 lbs) per acre from upland. Labor inputs have been estimated at 78 workdays per acre and 62 workdays per acre respectively (excluding pest scaring and harvesting which are assumed to be about the same). On this basis upland gives 19.2 lbs of rice per workday, but inland swamps only give 18.1 lbs per workday, so that they are certainly not worthwhile, even before allowing for the labor-investment. However, it must be said that the Survey's inland swamp yield estimates are surprisingly high. Spencer, for example, gives swamp yields as about 1 ton per acre and upland yields varying from .23 to .58 tons per acre in 1971/72; and the 1965/66 Agricultural Survey has .8 tons per acre on inland swamps and about half a ton on upland. If we take these last figures as nearer the average, productivities per workday are 23.0 lbs from swamp and 18.1 lbs from upland, which looks better; but is it worth the initial 94 workdays per acre of swamp conversion?

To answer that, we have to value the extra output from cultivating an acre of swamp--i. e. over and above what the same labor would produce on upland cultivation--and compare it with some valuation of the labor investment, to arrive at a rate of return. An acre of swamp rice takes 78 workdays and yields .8 tons of rice. 78 workdays on upland cultivation would have yielded .63 tons (based on the 1965/66 Survey's average yield figures). So there is supposedly a net annual gain of .8 - .63 = .17 tons of rice. Assuming a rice price of Le 100 per ton, this is worth Le 17. To obtain this, the farmer has to invest 94 workdays in the acre of swamp; but how do we value that investment labor? A first approximation is to apply the daily hired labor wage rate of Le .63 (including payment in kind) according to the 1970/71 Survey. The capital cost is 94 x .63 = Le 59.22, and the rate of return (17/59.22) is 28.7%. This seems quite a healthy rate of return. But 94 workdays is a lot of labor on top of the normal yearly workload, and it is doubtful that a farmer would in practice think it worthwhile putting in as much extra effort as that in a year for an extra 381 lbs (.17 tons) of rice. The most likely occurrence is that farmers clear small amounts of swamp--fractions of one acre--each year. An important point that arises from this exercise is not so much the fact that the rate of return to investment in swamps may be quite high, but rather that it is very sensitive to differences in the relevant variables. There are at least seven parameters that vary from place to place and from year to year: the two yields, the two annual labor inputs, the investment labor and its valuation, and the price of rice--not to mention questions of tenure security, social factors, tradition, relative unpleasantness and disease-proneness of swamp work, etc.

Some Considerations Affecting Livestock Investment

Turning next to questions of plowing, draught animals and large livestock in general, it is not easy to generalize usefully in this area, given the rather patchy information available. The benefits may be broadly listed as follows (they depend on particular circumstances, as do the costs):

1) Draught animals have greater power (rate of doing work) than men. The timing of operations especially in relation to first rains can be more accurate. But if possession of grazing land or plows and teams are limited, this advantage applies mainly to the more fortunate owners.

2) A man-hour steering a plow is easier work than a man-hour hoeing.

3) A larger area can be planted; but weeding labor may become a new bottleneck (as observed by W. I. Jones in his Mali village) if weeding is still done by hand.

4) Draught animals can, however, be used for inter-row weeding and even sometimes harvesting (e. g. groundnuts in Genieri, Gambia).

5) They can also be used for transport, either as pack animals or with a cart, the latter allowing a much bigger load but requiring adequate tracks or roads.

6) Animals, including non-draught, may concentrate fertility from their manure on home fields if they are grazed on uncultivated land and brought in at night (as in Bukoba District, Tanzania for instance, and Chento, Ethiopia). They convert weeds and waste (e. g. groundnut haulms, kitchen waste) into useable manure.

7) They can be used for other types of work such as lifting water (Persian wheel), threshing or milling; but there does not seem to be much of this done in the sub-Sahara area.

8) Animals and equipment can be rented to other farmers. (In Hausaland, Northern Nigeria, most of the land is permanently cultivated, so that maintaining oxen is expensive and appears to be only worthwhile if they are leased extensively to other farmers. This also gives the well-to-do individuals owning plows and teams prestige, in that others depend on them. The cost of an ox-team and plow is put at £70. A sample of farmers averaged 24 plow days hired out at about £0.75 per day; i. e. returning £18. Costs of feeding are £0.1 per day in the farming season. The rate of return to the initial investment looks low or even negative. It is perhaps not surprising, then, that only 13 farmers out of 171 farming units in a sample in Batagarawa possessed plows.)

9) Animals are liquid assets: they can be sold when quick money is needed, or even eaten in emergencies.

The following seem to be the major costs borne where draught power is used:

1) Costs of feed may be very low, especially where there is rough grazing. But where there is a limited area of common grazing land, it is evident that although the individual does not bear the cost of the marginal animal, the society as a whole does, with consequent overgrazing. Draught donkeys in Gambia are fed mainly on kitchen waste and groundnut haulms, however. Where land is very scarce, farmers have to pay for oxen to be boarded out on distant bush lands.

2) Much labor may be required to bring food to animals (draught or not) and to take manure to the fields.

3) Animals may require buildings, and crops may need fences to protect them from grazing animals.

4) Labor-time may be needed to guard grazing animals against predators.

5) Skill and knowledge will be required to manage animals.

6) Depreciation must be allowed for:
   (a) animals: according to a survey of Bako area, Ethiopia, a cattle/oxen ratio of 5 or 6 to 1 is required to maintain an oxteam;
   (b) equipment: blacksmithing will be needed, as well as plows, when animal powered implements are used.

7) Capital cost of animals: none of the studies I have read consider the operation of rearing draught animals. Are they home-reared or purchased? If the latter, who rears them?

It seems likely that where cultivated land is scarce, and where there is little unused grazeable land, the ownership of large livestock, for draught or not, will be confined to a few well-to-do farmers (unless, perhaps, there is co-operative ownership and cultivation). In Geniere, Gambia, plowing, mostly with donkeys but with oxen among the wealthier, expanded rapidly from 1962 to 1974. This all appears to have been concentrated on the goundnut crop rotated with grains, and has taken over former bushfallow land under millets. Elkan mentions a similarly rapid expansion in Senegal. Although the idea of plowing may have come mainly through government encouragement, the rapid growth must have been strongly influenced by the boom in the groundnut price, peaking

in 1973/74. Strangely, donkeys in the Kano area of Nigeria are used only for transport, despite Haswell's Gambian evidence that they are much cheaper all round for draught cultivation, are nearly as powerful as oxen, and do not require grazing land. No doubt much depends on the type of soil, the required depth of plowing and the speed with which the operations need to be done.

Speed and timeliness of sowing with regard to rainfall timing and quantity is perhaps the major advantage of draught cultivation, but that is not the only way of overcoming labor shortages in the face of urgency as affected by rainfall. Irrigation is a way of approaching the problem from a different angle--i. e. making rain less critical--and a way that might be superior in the long run and possibly less inequitable. There is strong evidence that where rainfall is heavy, as in much of Western Africa, minimum tillage, together with mulching, will prevent erosion. This is even more effective if slopes are reduced by terracing. Plowing per se may therefore have no advantages in these regions, although draught power could conceivably be used for terracing, shallow tillage and even mulching, which otherwise requires much labor.

Traditional Investment and Its Policy Implications

Much rural investment, especially in Africa, is generated by the direct application of unpaid family labor, rather than by buying capital goods. In other words, financial savings are not necessarily an important constraint on investment, contrary to what is generally assumed by development economists. But are traditional forms of capital sufficiently productive to warrant much consideration by planners? Surely, it may be argued, "modern" inputs give far higher rates of return. But things are not as simple as the comparing of rates of return might lead us to believe. It is useful, at this point, to refer to two different kinds of investment. The first type may be either created with unpaid family labor or be purchased, either directly or by hiring labor (e. g. to dig wells, construct bunds, etc.) Let us call this kind "labor-investment". The second kind is that for which creation by farm labor can be ruled out and which must be purchased--e. g. tractors. Let us call this "savings-investment". For a poor farmer, the foregoing of $X is more subjectively costly than the foregoing of $X by a richer farmer because, by definition, consumption is more scarce for the poorer man. Thus the poor farmer will be less likely to engage in savings-investment than the richer farmer, even if the money rate of return is identical for both of them. Put another way, the poor man will cease investing in savings-investment at a higher money rate of return than the rich man. Thus savings-investment is innately biased against the relatively poor. In the case of labor-investment,

by similar reasoning, poor farmers will tend to create a higher proportion of capital using their own labor than will rich farmers.

We can apply this kind of reasoning at the level of the policy-maker if we assume that he gives greater weight to a given increase in consumption by the poor than to that increase on the part of the rich. It will therefore follow that greater emphasis should be placed on traditional investment or labor-investment. In addition, research should have a greater orientation towards the improvement of traditional investment; and the way to start would be to study traditional investment first. Also, credit schemes, which tend to encourage savings-investment--and which in any case have not been too successful--will receive less emphasis than hitherto. It may be, too, that initial labor-investment will eventually lead to much higher rates of return from further investment--perhaps from savings-investment. This seems to be true, for example, of irrigation works established prior to the introduction of fertilizer and improved rice varieties in many areas.

One way of encouraging traditional investment would be by means of some form of land tax, in cash, kind or labor services. Rene Dumont says of the former French territories: "The old area tax, spent locally on projects visible to all, was not unpopular." A land tax, in proportion to area, with some allowance for land qualities, would tend to encourage the substitution of labor and capital for land, while the tax itself could be used to create social capital such as roads and buildings. A further incentive for private investment might be remissions of tax conditional on farm improvements. Probably a local tax would be preferable to a national one, so that accountability to the tax-payers would be more feasible and so that allowance could more easily be made for particular local circumstances. Clearly, there would be considerable problems in implementing such a tax, particularly arising from land tenure systems and from administrative abuse, and these should not be minimized; but it has been done before.

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Savings Deposits and South Korean Agricultural Cooperatives

Tae Young Lee, Dong Hi Kim, and Dale W. Adams

[Unlike most low income countries, cooperatives in South Korea have played a major role in mobilizing voluntary financial deposits in rural areas. This article describes national trends in savings deposits and cooperative development, and contributory policies. Information on three primary cooperatives in South Korea is presented for illustration.]

Background on Agricultural Cooperatives in Korea

The present system of agricultural cooperatives in Korea is the result of an evolutionary process. In 1907 local organizations were established in rural areas to extend short-term credit and other cooperative services to farmers. A nationwide federation of these local organizations, called the Cooperative Federation of Financial Associations (CFFA), was created in 1933. Close government control of the Federation was maintained through appointed officials in key management positions. Not all of the rural cooperative activities were included: the Korean Agricultural Association, founded in 1920, handled cooperative marketing, distribution of inputs, and commodity storage. In 1945 many of these activities were turned over to the CFFA. In 1956 CFFA was combined with the Korean Agriculture Bank, which dealt exclusively with institutional credit; separate agricultural cooperatives were again established in 1957. The new government in 1961 placed special emphasis on improving financial services in rural areas. As part of this, multipurpose agricultural

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cooperatives were established by merging the agricultural bank and the agricultural cooperatives. Currently, financial services for farmers in Korea are provided primarily by the National Agricultural Cooperative Federation (NACF) and associated county and township-level agricultural cooperatives.

The present cooperative system has three horizontal levels of organization: primary cooperatives at the township level, county cooperatives, and NACF at the national level. In 1975 there were more than two million member farmers in over 1500 primary multipurpose cooperatives, and 141 special purpose cooperatives. More than 80% of the farm households are members of primary cooperatives. The average primary cooperative has about 1200 members; special cooperatives are about half that large.

Currently this cooperative system carries out a wide range of activities aimed at improving the social and economic well-being of farmers. These activities include supplying farm inputs, marketing farm products, provision of credit and savings deposit services, mutual insurance, technical assistance, and some education. These programs are closely tied to government agricultural development policies. Provision of financial services through the cooperative system has been one of the major techniques used by the government to implement its rural development strategy.

Agricultural Credit Services: Over the last few years NACF and its county-level cooperatives have been allowed to conduct all types of banking business. This includes receiving deposits and making loans to farmers as well as nonfarm individuals. Government loans directed to farmers are made only through the cooperative system. As can be noted in Table 1, in the early 1960s government funds and money borrowed from the Bank of Korea made up a large part of the loanable funds handled by the cooperatives. By the early 1970s, however, deposits in the cooperatives made up a majority of the loanable funds.

It can also be noted in Table 1 that the total volume of loanable funds in the agricultural cooperative system increased from about 17 billion current won in 1961 to about 485 billion current won in 1975. In real terms, this was more than a four-fold increase. (The wholesale price index for all commodities in South Korea, with 1970 = 100, went up from 35.1 in 1961 to 238.0 in 1975.) Expanded private savings deposits in the cooperatives provided a large part of these additional loanable funds. These funds were used mainly for loans to members of the cooperatives, or for business operations of the agricultural cooperative system. Thus, most of the loans made by the cooperative system were for agricultural purposes: in 1962, 92% of the value of outstanding balances was for agricultural loans. In 1975 this was

lowered to 75%, reflecting the continued growth of nonagricultural economic opportunities in rural areas.

TABLE 1: Total Amount and Sources of Loanable Funds in Agricultural Cooperatives in Korea, 1961-1975

Year	Total Loanable Funds (million current won)	Percentage of total by source					
		Government Funds	Bank of Korea	Ag. Credit Debentures	Deposits Received	Foreign Loans	Coop's Own Funds
1961	16,911	57	18	2	20	-	3
1962	22,499	63	2	12	19	-	4
1963	27,727	55	12	8	20	-	5
1964	30,968	51	17	6	21	-	5
1965	44,200	33	37	20	24	-	4
1966	61,427	29	33	1	34	-	3
1967	73,391	26	33	Nil	38	-	3
1968	103,087	23	30	Nil	45	-	2
1969	158,221	26	21	Nil	48	4	1
1970	192,183	25	17	0	50	4	4
1971	212,636	24	19	0	51	2	4
1972	252,340	24	17	1	53	2	3
1973	312,889	21	19	1	54	1	4
1974	419,809	19	24	1	51	2	3
1975	484,600	16	12	N/A	53	1	N/A

SOURCE: Various unpublished reports by The National Agricultural Cooperative Federation.

Interest Rates: Some of the most interesting features of recent developmental policy in Korea are the major changes which have been made in nominal interest rates in formal financial markets. Prior to 1965, nominal interest rates in Korea were quite low. Formal agricultural loans, for example, carried interest rates of approximately 8-15% per year. Rates paid on financial savings deposits ranged from 9-15%. In September 1965 many of the interest rates on formal loans and deposits were almost doubled (Table 2). Time deposits of more than two years carried interest rates of 30%, for example. Since 1965 interest rate policies, especially on deposits, have been more flexible, with rates moving up and down depending on inflationary pressures. As can be seen in Table 2, these changes in nominal interest rates have resulted in positive real rates of interest in most years after 1964--over 10% during 1966-71 on long-term deposits.

The interest rate reforms in the mid-1960s increased the average rate of interest charged on agricultural loans. In 1964 none of the agricultural loans made by the cooperatives carried interest rates of more than 25% per year. In 1966 about 9% of the value of cooperative loans carried rates of 25% or more, and by 1968 almost 30% of the value of loans carried these higher interest rates. After 1968, however, interest rates were steadily lowered until 1973 when inflation induced policy makers to raise interest rates again.

Savings Deposits: Unlike many developing countries, rather heavy emphasis has been placed on mobilizing rural financial savings in

TABLE 2: Interest Rates and Financial Deposits in South Korea, 1963-1974

	Contractual Interest Rates on Long Term Deposits[1] (%)	Changes in Wholesale Price Index (%)	Real Rates of Interest on Long Term Savings Deposits (%)	Total Financial Deposits (billion 1970 won)[3]	% in Ag. Coops	Total Savings Deposits[2] (Billion 1970 won)[3]	% in Ag. Coops
1963	15.0	20.6	- 5.6	84.2	14	27.7	5
1964	15.0	34.6	-19.6	69.2	15	23.3	5
1965	18.0	10.1	7.9	114.4	14	44.6	9
1966	26.8	8.7	18.1	162.1	17	93.9	16
1967	26.8	6.4	20.4	259.3	14	162.3	12
1968	26.1	8.1	18.0	434.8	13	297.9	10
1969	23.8	6.8	17.0	676.0	12	492.9	9
1970	22.8	9.2	13.6	789.7	12	576.3	10
1971	22.1	8.6	13.5	900.2	11	652.6	9
1972	15.4	14.0	1.4	1069.4	10	736.3	8
1973	12.6	6.9	5.7	1324.5	10	917.0	8
1974	15.0	42.1	-27.1	1119.8	10	770.8	8

SOURCE: Bureau of Statistics, Economic Planning Board, *Korean Statistical Yearbook*, Vols. 16 (1969) and 22 (1975).

1. These rates are for deposits of 12-month maturity. When interest rates were changed during the year, a simple weighted average of months covered by the interest rate was used in the calculations.
2. Excludes checking deposits, other demand deposits, and short-term passbook deposits.
3. The price index used to convert to 1970 prices was the wholesale price index for Korea. The exchange rate of won for dollars in 1970 was 316.

Korea, and significant amounts of national savings have been deposited in agricultural cooperatives. As can be noted in Table 2, after the interest rate reform in late 1965, financial deposits in agricultural cooperatives increased from 14 to 17% of total financial deposits in the country. The proportion of total savings deposits in the country held by agricultural cooperatives also jumped from 9% in 1965 to 16% in 1966. Because of the very rapid growth in nonagricultural economic activities thereafter, the percentage of total financial deposits in the country held in agricultural cooperatives declined from 1966 to 1974. In part, the increases in real amounts of financial savings deposits in agricultural cooperatives over this period were due to ambitious savings mobilization efforts by the government. Three financial institutions in rural areas--Agricultural Cooperatives, the Fisheries Cooperatives, and the Post Office--are heavily involved in this activity. A nationwide campaign to promote rural savings has been carried out almost every year during the harvest season from September to December.

A further breakdown of deposits in cooperatives is shown in Table 3. In the early 1960s, the agricultural cooperatives in Korea handled relatively small amounts of financial deposits. In 1961 the total value of demand and savings deposits in these cooperatives was only 3.5 billion won. These deposits increased to 6.5 billion won by the end of 1964, and the sharp increase between 1964 and 1966 is evident in Table 3; total deposits more than tripled. In nominal terms, total deposits increased 35-fold from 1964 to 1974 in these three institutions; in real terms this was almost a 12-fold increase. These

increases in deposits were associated with significant changes at the farm-household level in the use of financial assets as shown in surveys and sample studies. In 1962, for example, representative farm-households held less than 2% of their assets in financial forms. By 1974 this had increased to more than 3%. Farm-households made even larger changes in their holdings of liquid assets. In 1962 only 11% of their liquid assets were in financial form, but by 1974 this had increased to 26%.

As noted in Table 3, less than half of the deposits in the agricultural cooperatives prior to 1966 were in savings accounts. From 1966 to 1974, however, savings deposits made up approximately two-thirds of total deposits. The sharp increase in inflationary pressures in 1974 and 1975 combined with lagging interest rate policies caused an abrupt shift back from savings to demand deposits.

TABLE 3: Amounts of Private Deposits and Value of Member-Share Purchases in Agricultural Cooperatives, 1961–1975 (year end balances in million current won)

	Deposits			Accumulated Share Purchases in:			
Year	Demand Deposits	Savings Deposits	Total	NACF	County Coops	Primary Coops	Total
1961	1,831	1,640	3,471	301	14	—	N/A
1962	2,946	1,304	4,250	306	330	—	N/A
1963	4,323	1,350	5,673	408	445	439	1,292
1964	4,702	1,748	6,450	414	469	996	1,879
1965	6,567	4,074	10,641	424	524	1,189	2,137
1966	7,586	13,362	20,948	439	583	1,596	2,618
1967	12,673	15,101	27,774	444	631	2,312	3,387
1968	20,144	26,639	46,783	446	715	2,787	3,948
1969	31,976	43,925	75,901	473	824	3,223	4,520
1970	39,209	56,207	95,417	520	1,060	4,678	6,258
1971	42,804	66,122	108,925	627	1,381	7,045	9,053
1972	56,516	76,225	132,741	917	2,032	11,532	14,481
1973	70,998	98,373	169,371	1,395	3,071	16,013	20,479
1974	98,529	117,323	215,852	2,372	4,870	24,116	31,358
1975	130,298	129,168	259,466	3,725	6,792	31,422	41,939

SOURCE: National Agricultural Cooperative Federation (NACF), *Agricultural Yearbooks*, 1962–1975, Seoul, Korea. Also NACF, *Agricultural Cooperative Monthly Review*, various issues.

Another interesting point stands out in Table 3. In most cooperatives around the world, involuntary share purchases by cooperative members provide a large part of the organization's operating funds. Share monies plus foreign or governmental assistance usually provide the bulk of loanable funds handled by the cooperatives. In Korea, however, share purchases are small in comparison with private voluntary deposits; from 1963 to 1975 they were only one tenth to one fifth the value of voluntary deposits. This is about the same pattern found among the highly successful Farmers' Association in Taiwan and Japan; financial deposits, not involuntary share purchases, were the cornerstones of these institutions.

Financial Services in Three Cooperatives

To illustrate the importance of credit and deposit activities in cooperatives, three primary agricultural cooperatives in Korea were selected for more intensive study. Each represents one of three main agricultural regions: the first was Daeson Cooperative, located in a mixed farming region. The second is the Chojeun Cooperative, located in a horticultural area, and the third is Ochang Cooperative, in a rice growing region.

During the past ten years a large number of the primary cooperatives have been involved in substantial reorganizations, so that most of the current primary cooperatives have historical records which cover relatively short periods. The Daeson Cooperative as presently constituted was founded in 1966, and the Chojeun and Ochang Cooperatives in 1969. These cooperatives have relatively large memberships--the Daeson Cooperative about 1,000 members, the Chojeun Cooperative about double that, and the Ochang Cooperative some 2,500. Cooperatives need to have relatively large memberships to be able to realize economies of size in their operations, and this is particularly true of financial services. It is impractical to offer credit and deposit services in cooperatives with small numbers of active members.

Credit Services: Information on the total value of loans outstanding at year-end by the three cooperatives is shown in Table 4. Lending activities in all three cooperatives have expanded recently at a rapid rate. In real terms, the amount loaned by the Daeson Cooperative increased 16-fold from 1966 to 1975; the Chojeun Cooperative experienced a real increase of 8-fold from 1969 to 1975; and the Ochang Cooperative a 29-fold real increase over the same period. Credit operations have grown to become a substantial part of the economic business of these three cooperatives. Detailed profit-loss information on the various activities carried out by these cooperatives was not available. It is likely that credit-savings operations provided a major part of "net income" generated by these cooperatives--indeed these financial activities appear to be the economic cornerstone of many Korean cooperatives.

TABLE 4: Total Value of Loans Outstanding at Year End in Three Selected Agricultural Cooperatives, 1966-1975 (in million current won)

Year	Primary Cooperatives		
	Daesan	Chojeun	Ochang
1966	1.3	—	—
1967	1.1	—	—
1968	2.4	—	—
1969	2.5	12.1	6.3
1970	6.4	32.8	25.3
1971	18.0	68.6	63.7
1972	18.1	97.2	134.2
1973	42.8	128.5	168.2
1974	48.8	124.7	161.0
1975	65.7	260.2	472.0

SOURCE: Unpublished records of three selected agricultural cooperatives.

In 1975 about 75% of the total value of loans made by the three cooperatives were for unspecified purposes. Undoubtedly, a major part of these loans directly affected agricultural activities. Most of the remainder of the loans were tied specifically to farming. Very little of this lending has been done in kind. Granting relatively untied loans such as these is, of course, not typical of cooperative lending activities in many low income countries; unrestricted lending is lower in cost, and indicates confidence in the value of borrowers' free choices.

Deposit Activities: The Daeson Cooperative began accepting financial deposits in 1966. As noted in Table 5, deposits in this cooperative increased substantially through 1975. Even more rapid increases occurred in financial deposits in the Chojeun and Ochang Cooperatives. In 1975 the three cooperatives had per-member deposits which averaged 291 thousand, 573 thousand, and 843 thousand won respectively, the equivalent of U.S. $601, $1,184 and $1,742 per member.

TABLE 5: Financial Deposits in Three Sampled Agricultural Cooperatives, 1966–1975 (in million current won)

Year	Primary Cooperatives		
	Daesan	Chojeun	Ochang
1966	.5	—	—
1967	.7	—	—
1968	2.2	—	—
1969	2.4	4.9	5.3
1970	12.2	138.2	45.1
1971	14.9	201.9	142.3
1972	80.0	304.6	321.8
1973	118.3	420.4	539.8
1974	163.1	719.0	N/A
1975	281.4	1,007.0	2,130.7

SOURCE: Unpublished records of the three agricultural cooperatives.

Various types of savings mobilization programs have been introduced in recent years to encourage savings deposits in the cooperatives. These include installment savings, deposits in kind, and mutual installment deposits. The mutual installment system is a mixture of the North American Credit Union approach to savings mobilization and the traditional Korean Ke system. Over the past few years the mutual credit-savings system has become a very important part of cooperatives' financial activities. As can be seen in Table 6, demand deposits made up about 75% of total deposits in these three cooperatives. Fixed savings deposits were 20% of the deposits, and the remainder was in other types of savings deposit programs. Share purchases (not included in the table) were only 16% of the value of voluntary savings deposits.

TABLE 6: Amounts of Deposits in Three Sample Agricultural Cooperatives by Type of Deposit, 1966–1975 (in million current won)

Year	Demand Deposits	Fixed Deposits	Mutual Installment Deposits	Installment Deposits	Deposits in Kind and Other
1966	—	—	.5	—	—
1967	—	—	.7	—	—
1968	—	—	2.2	—	—
1969	3.7	—	6.0	2.9	—
1970	152.3	—	8.6	27.8	6.8
1971	266.7	40.0	15.1	33.8	3.5
1972	564.3	73.2	24.8	29.1	15.0
1973	833.1	109.7	33.2	22.5	80.0
1974	984.0	110.5	43.3	19.0	8.3
1975	2580.0	694.0	94.2	23.7	27.2

SOURCE: Unpublished records of the three sampled agricultural cooperatives.

Cooperative Members' Attitudes Toward Savings: To explore the attitudes of members toward savings deposits, interviews were carried out with a random sample of 120 individuals, 40 members in each of the three cooperatives. The interviews showed that almost all of the members (92%) had deposit accounts in either the cooperative or a post office or both. Over one-third of those interviewed indicated they had opened a savings account at the urging of cooperative officials. In the Chojeun and Ochang Cooperatives, cooperative officials were reported to have been instrumental in bringing into existence half or more of the savings accounts opened.

During the interviews the cooperative members were asked to identify the source of money used to make their most significant recent deposits. Not surprisingly, over half of them said crop or livestock receipts. About 20% reported nonfarm or wage income as the source for the deposit. Another 13% reported frugal living as the source; and the remainder reported using money from several other sources. The interviewed members indicated that about half of the deposits were motivated by farm or household operations. Members clearly had a strong liquidity-for-transactions motive for making about half of their deposits. The other half of the deposits, however, appear to be closely tied to specified saving-investment decisions: about one-third of the deposits was for educational purposes, another 16% for land purchases, while about 3% was directed to some other type of investment. Deposit behavior seems to be strongly influenced by the rates of return which depositors expect from financial savings, or from the types of investments for which financial savings are accumulated.

In 1969, interviewed members held more than three-quarters of their financial deposits in post offices. By 1975, however, these same members held over 95% of their financial deposits in the primary cooperatives! It appears that the cooperative members

now view the cooperative as a safe and convenient place to hold their financial assets. It is also an indication that Korean farmers are doing an increasingly larger share of their economic transactions with the cooperatives.

Conclusions

Several interesting lessons can be drawn from the recent experience with mobilizing rural savings in South Korea. The first is that well-organized cooperatives can play a major role in mobilizing voluntary financial savings in rural areas. U Tun Wai has argued that three key elements are necessary before savings can be mobilized: 1) people must have sufficient resources or income to be able to save; 2) individuals must have secure and dependable opportunities to save; 3) savers must expect that their savings will result in substantial future satisfaction--they must have incentives to save. Agricultural cooperatives appear to have been particularly effective in providing secure and dependable opportunities for rural households to add voluntary financial savings to their asset portfolios.

The second major lesson which can be drawn is that government policies, especially interest rate policies but also savings promotion efforts, can strongly affect the ability of financial institutions like cooperatives to mobilize savings. These same policies can also strongly affect the incentives which rural household have to hold financial assets, and to save in general (rather than consume). Most rural cooperatives in low income countries mobilize very little voluntary or involuntary savings. Aside from a small number of cases, most cooperatives offer very low, or negative, real rates of interest on financial deposits. Further, they typically do not promote savings deposits. Many cooperatives act as retail outlets for credit without providing deposit services for members. In many cases cooperatives are too unstable to convince members that their savings deposits will be secure in the cooperative's care.

A third lesson suggested by the recent Korean experience is that low-income rural people may have much larger potential savings capacities than previously estimated. Hyun recently found that rural households included in the Annual Korean Farm Household Economy Survey saved surprisingly large parts of their income. In 1963 all households in the Survey saved an average of 12% of their household income; by 1974 this had increased to 33%. Even households with the smallest farms and households with the lowest incomes were saving significant amounts in certain years. This substantial savings capacity resulted both from interest rate policies, and because cooperatives and post offices were able to provide rural households with secure, convenient and inexpensive ways to save financially. Rural savers did not have

to travel thrity miles, pay for costly transportation, and lose a day of work in order to make a financial deposit. Deposit facilities were located in the depositors neighborhoods in rural areas; cooperative members could make deposits while they were transacting other business with the cooperatives.

A fourth lesson which might be learned from the recent Korea, Taiwan, and Japan experience is the important role which the right kind of credit-savings activities can play in building viable, small farmer service organizations like cooperatives. In all too many cases these organizations are called on to provide services in areas where they cannot initially compete efficiently. Informal marketing systems or other government sponsored services may in some cases be more efficient than cooperatives in providing production inputs, education and extension, and marketing of members' production. Furthermore, many cooperatives are forced to extend credit at low interest rates; this induces cooperatives to concentrate the loans in the hands of the influential to minimize lending costs, so that many members or potential members of cooperatives are denied credit and find it is not worth their while to be involved in cooperative activities. In Korea, Taiwan, and Japan, rural people appear to have had strong incentives to join and participate in cooperatives because of the excellent financial services which they offer. Because of the savings mobilized and the realistic interest rate policies in force, most members of the cooperatives have had access to credit services. With realistic national policies, it appears that cooperatives can efficiently provide these financial services. And these services not only strengthen the economic base of the cooperative, but also give members a strong reason for participating in other cooperative activities.

[Extracted from "Savings Deposits and Credit Activities in South Korean Agricultural Cooperatives, 1961-75", Asian Survey, Vol. XVII, No. 12, December 1977, pp. 1182-94, University of California Press, Berkeley, California. Copyright © 1977 by The Regents of the University of California, reprinted with permission.]

PLANTS WITH PROMISE

THE USE OF LEUCAENA TREES AS SHADE FOR PLANTATION CROPS, IN THIS CASE CACAO, IS ILLUSTRATED IN NEW BRITAIN -- SEE ARTICLE BEGINNING PAGE 72. (PHOTO: DEPARTMENT OF PRIMARY INDUSTRIES, PAPUA NEW GUINEA)

The Winged Bean: A High Protein Crop for the Tropics

Panel of the U. S. National Academy of Sciences

[This plant, which grows wild in most of Southeast Asia, has been ignored by agricultural experts and scientists and is regarded locally as a "poor man's crop. " Its potential value is described.]

Edible legumes are excellent sources of dietary protein and oils. Many nutritionists expect them to play an increasing role in meeting food needs in this time of food shortages and widespread malnutrition. In addition to the major cultivated edible legumes--soybeans, peanuts (groundnuts), peas, and beans--there are more than 50 minor tropical legumes that have received little scientific attention, mainly because researchers have concentrated on more conventional crop species, especially cereals. This report focuses on the exceptional promise offered by one of these: the winged bean, Psophocarpus tetragonolobus (L.) DC. Having considered all available information, we are persuaded that with research the winged bean can become a significant food crop in the humid tropics. We recommend that a major development effort be undertaken to test it in new areas and to expand the knowledge base that will make possible its most efficient exploitation.

Little research has been done on the winged bean; information, therefore, is limited. Today it is grown only as a backyard crop (rather than in a monocropped field) in Papua New Guinea and Southeast Asia. But these regions are typical of the humid tropical zone that encompasses large belts of Central and South

Report of an international advisory panel of 13 scientists, convened by a unit of the National Academy of Sciences, Washington, D. C.

America, the Caribbean, Africa, Oceania, and West Asia, areas where protein deficiency is high and the plant is still unknown. That an edible crop with such high protein content will grow in this region is uncommon. The winged bean appears to have great potential for easing the problem of protein malnutrition throughout the humid tropics.

The possibilities of the plant for improving the human diet have not been widely recognized. It is an exceptional legume: the green pods, leaves, and seeds are rich in protein and vitamins, and the tuberous roots are--among root crops--uniquely rich in protein. In addition, the seeds are a source of edible oil. Winged bean plants grow vigorously and have extensive root systems. Nitrogen from the atmosphere is "fixed" by bacteria in nodules on the roots and becomes incorporated into the plant, principally as protein. Compared with other edible legumes, the winged bean plants appear to have more and larger nodules on their roots. This superior nodulation may account for the plant's exceptional protein content.

Botanical Features

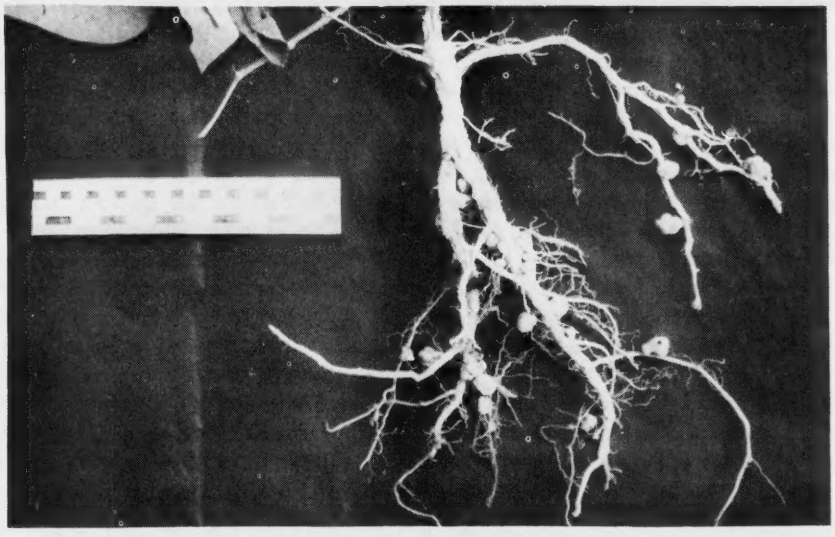
The winged bean is a climbing, herbaceous perennial vine; it can reach heights of 3-4 m (9-12 ft.) if supported on a pole. The blue, white, or purple flowers are self-pollinating. The pods are four sided with characteristic wings, vary in length from 6-36 cm (2-14 in.), and contain from 5-20 seeds each. The globular-shaped, shiny seeds may be white, yellow, brown, black, or mottled and vary in weight from 0.06-0.40 g. The pods develop in two stages. In the first, which takes about 20 days, the pod grows to its ultimate size. In the second, which takes about 44 days, the seeds mature and the pod surrounding them shrivels and dries out.

The winged bean develops an unusual amount of nodulation. Plants in Malaya carry up to 440 nodules each, and these nodules are unusually large. A single nodule may have a fresh weight of 0.6 g with a diameter of up to 1.2 cm (0.5 in.). Excellent nodulation without any need for inoculation appears to take place everywhere the crop has been grown. The bacterium involved is probably the common Rhizobium that nodulates many wild legumes and is sometimes spoken of as belonging to the cowpea group.

Environmental Requirements. The winged bean is now cultivated from sea level up to 2,000 m (7,000 ft.) and between 20° N and 10° S latitude in the Asian tropics. Its climatic requirements have not been studied in detail, but it appears to require a short day for normal flower induction. When grown outside the tropics, winged beans rarely flower; this seems to be caused by day-length differences (photo-periodic inhibition) and not by temperature. While the crop fares best in the humid tropics, it can be grown under irrigation

Above: Winged bean plants growing on poles. (Photo by S. K. Karikari)

Below: Winged bean roots and nodules.



with equal success in dry tropics, but it does not survive prolonged drought.

The winged bean does not appear to be demanding in its soil requirements. Although it will not survive waterlogged soil, it can adapt to a wide range of soils. Tropical soils are often poor in nitrogen, but the winged bean can grow in such soil, reflecting, perhaps, its ability to fix nitrogen from the air. The winged bean normally does not need inoculation with nitrogen-fixing bacteria to grow vigorously. Its seeds can be planted directly even into newly cleared soil--a major advantage over many tropical legumes that have to be inoculated when their bacterial strains are deficient in the soil. The winged bean could be a good restorative crop, which might meet the requirements of small-scale farmers in the tropics. It grows quickly and enriches the soil with nitrogen, especially if plowed under. Little is known, however, of its requirements for lime, phosphate, and other nutrients often lacking in tropical soils. Under irrigation, it has been grown successfully during the extended dry seasons in the Port Moresby area of Papua New Guinea The use of raised beds or mounds for winged bean production, a practice that improves drainage and stimulates tuber growth, is common in Papua New Guinea.

Biological Variation. At present, only a few varieties are available to investigators, and the observations on growth and management of winged beans are often based on single, or at most a few, cultivars. Studies of Papua New Guinean collections (over 100 varieties) reveal extensive genetic variability on the plant's ability to form tubers and produce seeds and pods. Varieties have been observed having different shapes, sizes, and colors of the pods, seeds, and flowers. Certain varieties are unable to form tubers, while others produce both tubers and seed.

	Range	Average
Seed yield in gm per plant	0.6 to 72.0	15.7
Length of pods in cm	5.8 to 26.4	15.2
Seed weight in mg	62 to 417	224
Tuber yield in gm per plant	1.3 to 50.3	15.9

Cultivation

Winged bean seed is sown at the beginning of the rainy season. The plant is grown as a single crop with poles or trellises, and begins to flower as early as 50 days in the lowland tropics or as late as 3-4 months at higher elevations. Although the plant grows vigorously once established, seedlings germinate and grow slowly during the first 3-5 weeks after planting. If weeds become estab-

lished among the young plants, they become entwined and are very difficult to remove.

Like many legumes cultivated in the tropics, the winged bean can be grown as an intercrop. For example, in Papua New Guinea, it is interplanted with sweet potatoes, sugar cane, taro, bananas, green vegetables, or other grain legumes. It is planted in a similar fashion in Indonesia, where it is also grown on the borders of rice paddies.

It is customary to support winged bean plants on poles (bamboo is often used) arranged either singly or in tripods. But on poles the plants sometimes grow so tall that some pods cannot be picked without using ladders; therefore, it is often more convenient to use a trellis or wire fence 1.20 m (4 ft.) high. However, where the crop is grown for its tubers, as in Burma, no supports are needed. The vines ramble over the ground, forming a vegetation cover about 30 cm (1 ft.) deep. In experiments carried out at the International Institute of Tropical Agriculture in Nigeria in 1971 and 1972, seed and pod yields of plants supported on trellises or poles were more than double the yield of unsupported plants.

Pests and Diseases. As currently grown in mixed garden culture or shifting agriculture, the winged bean is unusually free of serious pests and diseases. However, biologists and agronomists have noted that sometimes young flowers and pods are attacked by caterpillars, and the leaves can be damaged by leaf miners, grasshoppers, and spider mites. There is one record of a root-knot nematode on winged bean plants in Papua, New Guinea. Crown rot, false rust, and leaf spot fungi have also been observed. When the bean is more widely grown in monoculture it will probably be increasingly subject to disease and insect pests.

Harvesting: Green Pods and Dry Seeds. The pods may be eaten raw. They are highly palatable, taste like green beans, and seem readily accepted by those who have not previously eaten them. The first green pods are ready for picking about 10 weeks after sowing. About 2 weeks after pollination the succulent pod reaches its full length and can be used as a green vegetable; after 3 weeks the pod becomes fibrous and less palatable. If pods are not eaten whole, seeds may be harvested for food, or as a source of oil. After 6 weeks the seeds are mature and can be harvested. Winged bean seeds are similar to soybeans in digestibility and composition and require cooking for 2-3 hours. They may also be roasted and eaten like peanuts, or parched for eating (as in Java).

The plant may continue to bear pods indefinitely, but the experience of cultivators suggests that the rate of production declines after

several months. There is no definitive information on how long it is economically profitable to keep the crop in the ground. Farmers now treat the winged bean as an annual crop.

Tubers. To grow large tubers the plants are spaced 10-20 cm (0.5-1.0 ft.) apart and are allowed to trail. The tubers are harvested 4-8 months after sowing, when they reach 2-4 cm (1-2 in.) in diameter and 8-12 cm (3-5 in.) in length. The slightly sweet tuberous roots contain 20 percent protein (dry weight). This is much higher than the protein content in other edible roots and tubers such as cassava (1 percent), potatoes (2 percent), sweet potatoes (2 percent), or yams (2 percent). The plant grows in regions where people now depend on these low-protein root crops. No adverse effects have been reported from the use of winged bean tubers in foods.

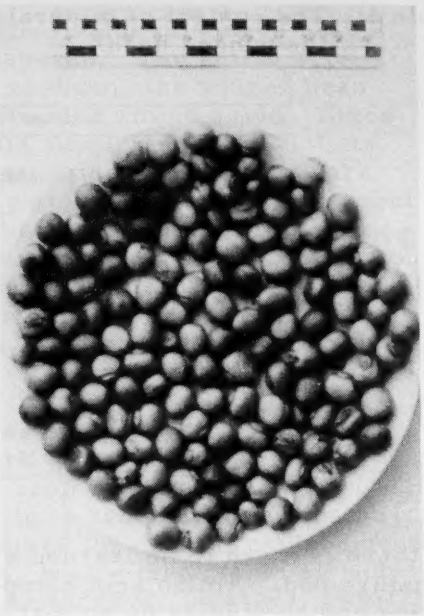
Productivity. Little documented information is available on winged bean yields. Green pods mature and are harvested as long as the climate remains favorable. The harvest ends usually with the onset of the cold season. Small-plot yields up to 1.9 tons of seed per ha (0.8 tons per acre) have been realized in Papua New Guinea; in Ghana and Nigeria, during several years of experiments using a P. tetragonolobus variety from Papua New Guinea, seed yields of 1.2-1.4 tons per ha (0.5-0.6 tons per acre) have been routinely obtained; up to 2.4 tons per ha (1 ton per acre) were recorded in agronomic trials at the International Institute of Tropical Agriculture (1974) in Ibadan, Nigeria.

Tuber yields have not been reliably measured in large plantings. In small plots in Ibadan, from 600-1,300 kg of fresh tubers per ha (600-1,300 lbs. per acre) were obtained; in addition, multiple harvests produced 2.2 tons and 1.8 tons per ha (0.9 and 0.7 tons per acre) of dry seeds. Fresh tuber yields exceeding 4.0 tons per ha (1.6 tons per acre) have been reported from Burma. It seems likely that tribesmen in the highlands of Papua New Guinea realize higher yields by using cultivation practices (e.g., plucking off the flowers) that enhance tuber growth.

It seems highly likely that yields can be increased by research. No genetic selection has yet been undertaken, nor any sort of interbreeding to augment desired qualities. There has been little investigation of the best methods of cultivation.

Nutritive Value

Winged bean seeds have some 30-35 percent protein, and the tubers 12-15 percent (using a fresh weight rather than dry weight measure). Some data on mineral and vitamin content are shown in the table below (values are in mg per 100 mg of fresh weight).



Above left: Winged bean pods.

Above right: Winged bean seeds.

Below: Winged bean tubers.

Table 1. The content of minerals and vitamins in different parts of the winged bean.

Component	Immature Pod	Seed	Tuber
Minerals			
Calcium	63 - 330	204 - 370	40
Magnesium		120 - 204	
Potassium		110 - 120	
Sodium		20 - 56	
Phosphorus	60	320 - 276	64
Iron	1.3 - 1.7	9.6 - 11.8	3.0
Vitamins			
β-Carotene	0.54		
Tocopherols		126	
Thiamin	0.06	1.4	
Riboflavin	0.12	0.2	
Niacin	0.5		
Ascorbic acid	22 - 37		

But there is much to be learned about the nutritional value of the immature pod. Amino acid composition data, for example, are lacking and no studies on animal growth have been reported. No adverse effects have been reported despite the widespread consumption of the pods (raw and cooked) and seeds in Southeast Asia.

The nutritive quality of the cooked bean, as assessed by the Protein Efficiency Ratio (PER) and Net Protein Utilization (NPU) values, compares well with that of soybean. These conclusions are based on the data presented in Table 2. Although the diet containing only winged bean seeds (at a level providing 10 percent protein) does not show a nutritive value as high as skim milk, combining the winged bean with maize (corn) does. Nutritionally, the winged bean is superior to the peanut. Of special significance is the report that a flour made from the winged bean was suitable as a milk substitute in the treatment of children suffering from kwashiorkor.

Table 2. The nutritive value of the winged bean as measured in rats.

	10% protein		16% protein
Protein component of diet	PER	NPU	PER
Winged bean	2.14	55.0	2.00
Peanut	1.53	46.2	
Skim Milk	3.04	73.2	2.37
Winged bean plus corn	2.70	65.7	2.20
Peanut plus corn	1.92	54.7	1.82
Soybean	2.10	56.0	

These results indicate that the nutritive value of winged bean seed-protein is similar to that of the soybean. The amino acid composition is also similar. Like the soybean, the winged bean is somewhat deficient in the sulfur-containing amino acids. Since the winged bean is rich in lysine it could supplement cereal diets that are lysine deficient. Like soybeans, winged bean seeds are rich in oil (15-20 percent). Of the fatty acids in the oil, 71 percent are unsaturated. If extracting the oil becomes commercially feasible, the residual meal should be an excellent protein source analogous to soybean meal. The seeds are also rich in tocopherol--an antioxidant--that improves the utilization of vitamin A in the human body. This is important since vitamin A deficiency is common in many tropical countries.

The winged bean's tuberous roots, as noted above, are rich in protein (12-15 percent wet weight, more than 20 percent on a dry weight basis). An edible tropical root crop with such a high protein content could be of great value in helping to reduce protein malnutrition. This is especially important since the natural environment of the winged bean is the humid tropics, where inhabitants already live on root crops low in protein such as cassava, potatoes, yams, taro, and sweet potatoes, whose exclusive consumption leads to protein deficiency and kwashiorkor. The winged bean tubers are eaten like potatoes--sometimes raw, but more frequently cooked. In Papua New Guinea, they are wrapped in banana leaves or in bamboo and cooked in a large earth-oven or in a fire. In Burma, the tubers are boiled until soft, then are peeled and eaten as a snack with a sauce made from vegetable oil and salt.

The leaves and flowers may be eaten either raw or cooked; the flowers are added to salads. In Burma, salads are made from leaves that have been boiled briefly; the leaves are also added to fish and prawn soups. In the highlands of Papua New Guinea, the flowers are fried in oil and have a taste suggestive of mushrooms.

Like all other parts of the plant, the foliage has a high protein content (5-15 percent of fresh weight). The protein percentage of dry matter for the whole above-ground part of the plant is 25.6 percent in some experiments. If this figure is confirmed as being a fair average, the leaves of the winged bean would have one of the highest protein contents of tropical forage legumes. After harvesting the crop of pods, seeds, or tubers, the haulm can be fed to animals, who find it palatable.

Research Recommendations

Almost nothing is known of winged bean varieties, which have yet to be collected and established in nurseries for the proper develop-

ment of the plant. The few varieties now cultivated require staking to produce high yields of pods and seeds. Because this method of agriculture is impractical and uneconomical for mass cropping, and because not all winged bean pods mature at the same time, the plant is not likely to rival the soybean as a large-scale commercial product in the near future. For now, its potential is as a subsistence crop or as a cash crop for small markets. For these purposes, the fact that it produces food during many months is an advantage, and staking is not a serious handicap. However, it must be remembered that most wild legumes have climbing growth habits similar to those of the winged bean; even wild soybeans and wild lima beans grow this way. The specific varieties of these plants that are now cultivated have been bred for the self-supporting growth necessary for large-scale farming. There is a pressing need to find and develop similar self-supporting varieties of winged bean.

What is known today about the winged bean is roughly tantamount to what was known about the soybean 60 years ago, shortly after its commercial introduction to the United States. Many advances in the genetic improvement of the soybean could be applied to the winged bean. It is possible that the winged bean may be as significant for world agriculture in the future. The techniques for producing soybean flour and protein concentrates for use in foods could be applied to winged bean processing. The winged bean has several nutritional advantages over the soybean. All parts of the plant can be eaten--tubers, seeds, leaves, flowers, and shoots--whereas only seeds of the soybean are used. The bitter, beany flavor of many soybean products appears to be absent in the winged bean, which could encourage its widespread introduction into the human diet.

Because of the exceptional qualities of winged beans we believe that the plant deserves intensive investigation and testing in experiment stations in diverse regions of the tropics. To do this piecemeal will not be as effective as mounting a coordinated effort to distribute seeds and to collect, collate, and compare results. Much of the testing can be carried out by local stations, but the coordinating function cannot. For this, some sort of international mechanism is required.

[Extracted from The Winged Bean: A High Protein Crop for the Tropics. Report of an advisory panel of the Board on Science and Technology for International Development, Commission on International Relations, National Academy of Sciences, Washington, D. C., 1975.]

Note: Original report available without charge from: Commission on International Relations (JH 215), National Research Council, 2101 Constitution Ave., Washington, D. C. 20418, U. S. A.

Jojoba: A Promising Crop for Arid Lands

Committee of the U. S. National Academy of Sciences

[The jojoba grows naturally in some very dry areas of North America, and its reeds yield oil products which would have good industrial markets if produced in quantity.]

The desert plant jojoba (Simmondsia chinensis) grows wild over an extensive arid area in the Sonoran Desert that covers parts of Arizona, California, and the northwest of Mexico. Estimates of the amount of seeds produced each year in jojoba's native habitat are over 100 million pounds. The cultivation of jojoba, the manufacture of products from it, and the utilization of its by-products would greatly improve the economic situation of some peoples in the area, and in other arid zones.

Jojoba seeds (see Figure 3) contain about 50 percent by weight of a colorless, odorless oily liquid with unusual properties that is commonly referred to as "jojoba oil". The oil is chemically a liquid wax made up of nonglyceride esters having a narrow range of chemical composition; the esters are almost entirely composed of straight-chain acids and alcohols, each with 20 or 22 carbon atoms and 1 unsaturated bond. Jojoba oil is unique: an unsaturated, liquid wax that is readily extractable in large quantities from a plant source. Waxes of this type are difficult to synthesize commercially; the only other natural source is the sperm whale, which is now an endangered species.

A Committee to assess this plant was appointed by a unit of the National Academy of Sciences, Washington, D.C.

Waxes are used in many industries for a wide variety of applications in lubricants, paper coatings, polishes, electrical insulation, carbon paper, textiles, leather, precision casting, and pharmaceuticals. Jojoba oil is potentially useful for all these products.

Liquid jojoba oil can be hydrogenated to a hard, colorless solid resembling spermaceti (a solid saturated form of sperm oil also obtained from sperm whales), carnauba wax, and beeswax in both chemical structure and properties. The completely hydrogenated wax has a high melting point, about 70 C. It is noteworthy that the price of natural and synthetic waxes has risen greatly in recent years; they now sell for record prices.

Substantial chemical research has been done on jojoba oil, much of it in the 1950s by the U. S. Department of Agriculture. Though much is known about the physical and chemical nature of jojoba, industrial development is just beginning. In 1974, 35 acres jojoba plantation were established on Indian lands in southern California, and two Indian jojoba cooperatives were formed in California and Arizona.

The jojoba plant, although usually bushy, may grow 10 feet high, offering a thick cover in the desert (see Figure 1). Its natural life span appears to be more than 100 years, perhaps more than 200. A nontoxic plant, it is browsed by cattle, sheep, and goats. Jojoba is dioecious; i. e. pollen is produced on "male" plants; the "female" plants bear the seeds, which are about the size of peanuts. Jojoba is native to the Sonoran Desert of Mexico and the United States, where it occupies elevations between 2, 000 and 4, 000 feet, rarely occurring lower, although it is found down to sea level along the outer coast of Baja California. Jojoba is usually restricted to well-drained, coarse desert soils and coarse mixtures of gravels and clays. The plant has shown the ability to develop without additional water in an area with an annual rainfall of 8 inches. It is most prevalent where the rainfall is 15-18 inches a year, although it does occur in areas where the rainfall is less than 5 inches. Mature plants in the United States are known to yield as much as 12 pounds of seeds (dry weight) and more. Jojoba does not appear to be subject to serious insect or disease damage.

The Commercial Potentials for Jojoba Products

The committee concludes unanimously that jojoba oil and its hydrogenated product have marketable properties. There is a sound technical basis on which to move forward in establishing jojoba-based industries. Jojoba oil is a new product with numerous important potential applications, but its development can reliably rest on its ability to substitute for existing oils and waxes such as sperm oil, carnauba wax, beeswax, and spermaceti. The wax-ester structure of jojoba oil is not easily synthesized in commercial quantities, nor is it readily available

from any other natural source, except the sperm whale. The possibility of displacement by synthetics therefore appears remote.

Preliminary experiments at the University of California at Riverside, and in Israel, demonstrate that jojoba plants can be cultivated, and their yield greatly improved over that of plants in the wild. Under cultivation, an average annual yield of 5 pounds of clean, dry seeds can be obtained from a mature bush; a plantation could yield 1,000 to 2,000 pounds of oil per acre per year. Start-up costs (estimated in 1975), if irrigation water is available, are estimated to be $1,500 per acre on average agricultural land and as high as $2,800 per acre in rough desert terrain; but plantation maintenance costs, including harvesting, would be only about $100 per acre per year. From the current price of sperm oil (40¢ per pound) and of carnauba wax ($2 per pound), it can be seen that returns per acre from established jojoba plantations would be substantial.

Jojoba and Sperm Oil

Jojoba oil resembles sperm oil in chemical composition and physical behavior; if a sufficient supply of jojoba oil were available at a competitive price, it would be used as a substitute for sperm oil. The structural similarity of the two is indicated by an identity of chemical-compound type (wax esters as opposed to the glycerides of other natural oils and fats), almost identical unsaturation (number of double bonds) in both the acid and the alcohol portions of the wax esters, and similar molecular chain lengths. Evidence presented to the committee has shown conclusively that jojoba oil can duplicate sperm oil performance as a high-pressure lubricant. As this is the major use for sperm oil, it is strong evidence that, technically, jojoba is a marketable commodity. In the past, sperm oil found extensive use in United States industry as a lubricant in automotive and tractor transmission fluids, in metal-working oils, and for gears and other machine parts requiring extreme-pressure properties. In all these applications, jojoba oil has the needed characterics to replace sperm oil practically on a one-to-one basis.

In December 1970, under provisions of the Endangered Species Conservation Act, the United States banned import of oil, meat, and other products from whales. Sperm-oil consumption in the United States averaged about 50 to 55 million pounds per year in the late 1960s; about half was used in lubricants, particularly for extreme-pressure conditions. The sperm-oil import ban has spawned several sperm-oil substitutes: selectively formulated lard oil or petroleum products with proprietary additives to meet the requirements of specific uses. In comparison with these formulated substitutes, jojoba is a virtual sperm-oil duplicate--a material that is so close in a chemical structure that it can probably be used as a sperm-oil

substitute for the complete range of uses, without requiring major reformulations.

Chemically, jojoba oil has industrial advantages over sperm oil: It is more than 97 percent wax esters. It contains no glycerides, very little (1 percent) free acid or alcohol, and almost no hydrocarbons, steroids, or other contaminants. Sperm oil, on the other hand, contains considerable amounts of glycerides (sometimes over 20 percent) and often free acid as well. Jojoba oil has almost no odor.

The Market for Hydrogenated Jojoba Oil

One jojoba product that has an immediate market potential is hydrogenated jojoba oil. This hard, white, semicrystalline wax has chemical structure and properties very like those of carnauba wax. These properties seem to assure it a future role in industry. Carnauba wax is laboriously scraped from the fronds of palm trees in Brazil. In recent years, the supply has fluctuated greatly and decreased generally, and with rising costs it is becoming a high-priced item: The highest grades sold at over $2 per pound in 1974. Other waxes with carnauba-like properties (candelilla, bees-wax, spermaceti) are also drastically rising in price and fluctuating in supply. If hydrogenated jojoba oil could be developed into a reliable wax source with a continuous supply of uniform quality, its market should be substantial.

Jojoba for Improving the Productivity of Arid Lands

Jojoba can increase the productivity of arid lands not suitable for conventional crops. The jojoba plant tolerates extreme desert temperatures; daily summer highs of 110-115 F in the shade are common in its habitat. According to the literature, 12 inches of rainfall a year are enough to support large stands of productive jojoba bushes. Jojoba would levy only a small strain on water supplies where these are heavily taxed by population growth and water-demanding crops, and water tables are threatened. A true drought-resistent desert shrub, jojoba grows well under marginal soil and moisture conditions.

Perhaps jojoba's greatest attribute for arid lands is that it requires little or no water during the summer (or other dry season). To produce new growth, set flowers, and produce seeds, jojoba needs moisture during the winter and spring (wet season). From the time the seeds are formed in the late spring, moisture is unnecessary. This schedule fits well with many arid environments; water is needed when it is most available and not needed when it is scarce. This schedule contrasts with most other crops, which

Figure 1: Jojoba plants being harvested.

Figure 2: Jojoba plant pruned for easy harvest.

Figure 3: Jojoba seeds, oil and wax. (Photo: L. Battaglia)

survive drought only if they receive moisture during the hottest and driest months. Jojoba also seems very tolerant of saline and alkaline soils and saline irrigation water--the cause of barrenness in many arid areas. With careful management, jojoba may be able to make these areas productive.

Development Indicated

Research and development support should now be committed to the jojoba oil supply problem. The committee is convinced of the value of jojoba products; to produce them in quantity is now the challenge. Natural stands cover large areas of the southwestern United States and of Mexico, but the vagaries of weather and the remote, steep terrain, unkempt bushes, and extreme heat during harvest time make it uneconomic to exploit them. The future of jojoba lies in developing it into a cultivated crop.

That the plant responds favorably to cultivation is known from the small plantations that have been established. These efforts should be expanded and new plantations initiated. Increased investment is needed because jojoba plants do not bear harvestable quantities of seed for 5 years. This long time required for the plantation to reach maturity, coupled with the present lack of established markets, makes cultivation a commercially risky proposition. The committee believes that this unique agricultural product is well worth subsidizing. They expect that the product can ultimately become self-supporting. The acceptance of any natural product, however, is limited by availability of an assured supply: no one will be willing or able to begin marketing (or ordering) the material until an ample, stable supply is being produced. This consideration is an important reason for starting plantations on a sufficient scale, say 2,000 acres with 400 acres planted per year.

Limitations and Research Needs. Jojoba production suffers from three constraints: (1) newly planted seedlings require 5 years before they bear adequate amounts of seed for commercialization; (2) there has been little agronomic selection; and (3) the available seed produces highly variable plants. Though the average is 5 pounds of seed per bush, some yield 12 pounds, others 1.5 pounds. We are unable to distinguish between male and female seeds, so that several seeds must be wastefully planted at each plant site to ensure that the desired sex is obtained. Research is needed to overcome each of these limitations. Success in any one will ease and quicken the development of the plant as a commercial crop.

The committee has noted a number of promising areas for productive chemical research: 1) Knowledge of jojoba oil is based on experiments with the naturally occurring oil, which has cis double bonds. Recent work has shown that catalysis gives almost instantaneous isomerization to a mixture in which the trans double bond predominates 4:1. This mixture has been virtually unstudied. 2) Addition of sulfur chloride to the double bonds of jojoba oil produces Factices ranging from viscous liquids to rubbery solids. An array of possible products awaits industrial testing and analysis. 3) Partial hydrogenation of jojoba oil (instead of complete hydrogeneration) produces a range of soft waxes, possibly with important industrial properties. 4) Combinations of hydrogenated jojoba oil with paraffin, with polyethylene, and with carnauba wax also provide products with different properties, many of which may be commercially important.

[Extracted from Products From Jojoba: A Promising New Crop for Arid Lands. Committee on Jojoba Utilization, Office of Chemistry and Technology, National Research Council, National Academy of Sciences, Washington, D. C., 1975.]

Note: The authors of this report concentrated on North American markets and growing conditions; there has been little experience in other areas. The scientific data examined are elaborated more fully in the original report, which supplies references to the literature; readers may form judgments as to utilization in different conditions. The report may be obtained without charge from:

Office of Chemistry and Chemical Technology
National Research Council
2101 Constitution Avenue
Washington, D. C. 20418, U. S. A.

Leucaena: Forage and Tree Crop for the Tropics

Philippine and United States Panels

[The leucaena, whether in its low bushy varieties or its tall trees, has a number of uses: for reforestation, wood plantations, interplanting and soil restoration, and as a high-protein cattle feed.]

Of all tropical legumes, leucaena probably offers the widest assortment of uses. Through its many varieties, leucaena can produce nutritious animal forage, firewood, timber, and rich organic fertilizer. Its diverse uses include revegetating tropical hillslopes and providing windbreaks, firebreaks, shade, and ornamentation. Although individual leucaena trees have yielded extraordinary amounts of wood--indeed, among the highest annual totals ever recorded--and although the plant is responsible for some of the highest weight gains measured in cattle feeding on forage, it remains a neglected crop, its full potential largely unrealized.

Inasmuch as the varieties with exceptional size, vigor, and other desirable qualities have been discovered or developed only during the past two decades, experience is still limited and literature sparse. Moreover, leucaena's reputation has suffered in some areas due to an aggressive variety that has become a weed. Further, leucaena's development has been retarded because its foliage contains an uncommon amino acid, mimosine, that is toxic to nonruminants at levels of about 10 percent in the diet. Leucaena is not fatal to ruminants such as cattle, however.

A joint report by panels of the Philippine Council for Agriculture and Resources Research, and of the Board of Science and Technology for International Development of the U. S. National Academy of Sciences.

Leucaena is the common name for Leucaena leucocephala, a tree which originated in Central America. After their conquest of Mexico the Spanish organized trade with the Philippines, and sometime during the next 250 years leucaena became firmly established in the Philippines, Guam, and other Spanish west-Pacific island possessions. Local people soon learned that it made good firewood; later, plantation owners found that coffee, cocoa, cinchona, pepper, vanilla, and other shade-loving crops established themselves well beneath an overstory of this leucaena variety. Accordingly, leucaena was introduced to plantations in the Netherlands East Indies (now Indonesia), Papua New Guinea, Malaya (Malaysia), and other countries of Southeast Asia. During the nineteenth century it was taken to Hawaii, Fiji, northern Australia, India, East and West Africa, and islands of the Caribbean. It is now truly pantropical.

The variety that became so widely disseminated descended from the Acapulco type and is now known as the Hawaiian type. This includes several short, bushy varieties 5 m (15 ft) in height that flower when very young (4-6 months old). This type flowers year-round rather than seasonally. Compared with the two types mentioned below, its yield of wood and foliage is low; its continuous flowering produces many seeds and it becomes an aggressive weed. Its value lies particularly in its ability to revegetate tropical hillslopes, to provide firewood and charcoal, and to shade plantation crops. A second variety is the Salvador type: tall trees growing to 20 m (65 ft) in height, having large leaves, pods, and seeds, and thick, branchless trunks. They often produce more than twice the biomass of wood compared to the Hawaiian type. (Some extremely high-yielding Salvador-type cultivars now being planted as sources of timber, wood products and industrial fuel are known as "Hawaiian Giants".) Third is the Peru type: tall plants to 15 m (45 ft), like the Salvador type, but with extensive branching even low down on the trunk. They produce little trunk, but extremely high quantities of foliage grow on their branches. These are highly productive forage varieties, but they have only recently been discovered and their use outside Australia, Hawaii, and Mexico still awaits testing.

Leucaena is a species of the family Leguminosae and, like most most other legumes, can form a mutually beneficial partnership with soil bacteria of the genus Rhizobium. These bacteria penetrate young rootlets and multiply to form nodular swellings on the root surface. The Rhizobium in the nodules is capable of absorbing large amounts of nitrogen gas from air in the soil, transforming it into nitrogen-containing organic and inorganic compounds. This process, which converts otherwise unusable nitrogen gas into compounds used by the legume to form proteins, is known as "nitrogen fixation". (See Development Digest, October 1975, p. 18.) Leucaena usually has large and prolific nodules and requires little or no fertilizer-nitrogen because the Rhizobium alone provides nitrogenous compounds

in amounts adequate for normal growth. This permits leucaena to thrive in some soils where nitrogen levels are inadequate to sustain the growth of most other crops.

The nodules occur on rootlets in the aerated surface soil layers, but leucaena develops a taproot that penetrates deep soil layers and exploits water and minerals below the root zone of many agricultural crop plants, which helps it to grow where other plants fail. Successful growth in a wide range of environments is a hallmark of leucaena. True, it is restricted to the tropics and subtropics, and within that huge region to elevations below about 500 m (1,500 ft); the plant continues growing at high elevation, but without its lowland vigor. But it withstands large differences in rainfall, sunlight, and land terrain, as well as periodic inundation, fire, windstorm, slight frost, and drought. Leucaena grows best where annual rainfall is 600-1,700 mm (25-65 in.). However, it grows well even where there are long, severe, dry seasons. In its native Mexican habitats in Yucatan and Guerrero, leucaena survives where no rain falls for 8 1/2 months a year. In this area, it is often the only forage that remains green and productive year-round. Although leucaena tolerates partial shade, it grows best in full sun. It becomes defoliated with even occasional light frosts, but with returning warm temperatures the plant bursts with greenery once again.

By reaching deeper for nutrients and water than most crop plants, leucaena's root system allows it to tolerate a wide array of soil conditions. Leucaena is found in soils varying in texture from rock to heavy clay to coral. It is commonly found growing from almost vertical cliffs. Unaided, leucaena grows well only in neutral or alkaline (especially limestone) soils. It grows poorly in acidic soils, and much of the tropics has acidic latosolic soils high in alumina and often deficient in molybdenum and zinc. To make leucaena grow well in such soils is a challenge. That it can be done is shown by legume trials on an acid (pH 4.2) latosol at Belém in Brazil's Amazon region. Leucaena was easily the most productive legume in the trial, but to get it established required lime pelleting and the use of molybdenum and fertilizer containing phosphorus, sulfur, and calcium. The plant has considerable salt tolerance and grows in exposed coastal areas--often right down to the high water mark.

Leucaena shows high resistance to pests and diseases, but experience is based largely on the Hawaiian type. A common pest is the seed weevil, which attacks the young pods and eats the developing seeds. In Malawi, termites attack young seedlings, which then must be treated with insecticide, or planted in extra numbers at the outset. Seedlings of all varieties are relished by goats, feral animals, rats, deer, wallabies, and other wildlife. Sometimes much perseverance (or fencing) is needed to get a plantation through the seedling stage.

Right: Cows eating foliage of leucaena trees. (Photo: T. H. Stobbs)

Left: Leucaenas growing under conditions of controlled cutting for forage.

Right: Nursery in the Philippines for large scale production of Salvador-type leucaena trees.

Animal Feed

There is an acute shortage of animal feed throughout the tropics. Nowhere is the shortage worse than in the seasonally dry tropics--vast scattered areas where recurring dry seasons preclude shallow-rooted perennial forage grasses and pasture legumes. Leucaena pastures are some of the most productive in the tropics; they promise to become especially useful forage sources for the dry tropics. Young or mature, green, dry or ensiled, the foliage is relished by livestock as well as wildlife--particularly when green feeds are scarce. Succulent young leucaena foliage is mainly used to feed cattle, water buffalo, and goats, which are less affected by mimosine than other animals. It can be harvested and carried fresh to the animals, dried into a leaf meal, or fermented to silage. Alternatively, cattle can be allowed to browse the standing bushes. For grazing purposes, short and multibranched Peru-type varieties are best, for they yield more leafy foliage within reach of cattle. However, some new varieties are being bred and tested which may prove still more productive.

Leucaena can be cropped for forage several ways. It can be grown as a range plant in scattered untended stands, in intensively cultivated pastures, in small plots, or along fencelines and roadsides. The plants can be browsed by free-ranging cattle, or hand harvested and hauled to the cattleshed. They can also be mechanically harvested using machinery developed for bulk handling other forage. The herbage, which can be fed fresh or sun-dried, can even be fed as the dehydrated product from a commercial alfalfa (lucerne) dryer. With this adaptability leucaena can meet the needs of small-scale farmers both in rural areas and on the periphery of cities, as well as the needs of feedlot operations and of ranching on tropical rangelands.

Alternatively, leucaena can be grown interspersed among fast-growing pasture grasses. Its leaves allow sunlight to filter through to the grass, and the combination makes a highly productive two-level pasture. Established leucaena is compatible with the most vigorous grasses, e.g., pangola, Brachiaria decumbens, and guinea grass (Panicum maximum), and under heavy grazing the combination remains well-balanced so that neither leucaena nor the grass dominates. In northern Australia leucaena/pangola grass pastures have retained balanced proportions for 4 years. Once they reach a height of 1 m (3 ft), the plants can be browsed, but both overgrazing--which cuts forage yield--and undergrazing--where plants grow too tall for cattle to reach--must be guarded against. If it grows too tall, leucaena can be chopped back (mechanically or by hand).

Yield. The plant is a prolific producer of leaves, flowers, pods buds, and twigs (all of which are eaten by cattle), and with careful management leucaena fields can maintain heavy yields and survive heavy grazing. Forage yields are between 2 and 20 tons per ha (1-10 tons per acre) of dry matter, including a small proportion of inedible, woody stems. From the best forage varieties on good sites, annual yields of edible dry matter are 12-20 tons per ha (6-10 tons per acre). This is equivalent to the annual production of 800-4,300 kg of protein per ha (800-4,3000 lb per acre). In the dry tropics, yields are reduced because the plants are stressed during the dry season, but good forage varieties will produce 8 tons of edible dry matter per ha (4 tons per acre). Irrigation can increase this to the higher levels, however. These yields compare favorably with those of the finest forage legumes such as alfalfa.

The whole leaf contains both nutrients and roughage and makes a more-or-less complete ruminant feed, pretty much comparable to alfalfa forage. Leucaena leaflets, which can be readily separated from the leaf stems, make a high-protein feed for they contain 27-34 percent protein.

Mimosine. When diets contain less than 30 percent leucaena (dry weight), cattle thrive for prolonged periods. But when leucaena makes up more than half the diet, and feeding is continued for more than 6 months, the result may be general ill-health with loss of tail and rump hairs, excessive salivation (drooling), and poor growth. Sheep may lose their wool, or have it so loosened that it can easily be pulled off. The cause has recently been traced to the underproduction of thyroxine by the animal's thyroid gland, which results in goiter. Swollen thyroids (goiters) are common among cattle feeding on leucaena. The cause is 3,4-dihydroxypyridine (DHP) 2 created in the animals' rumens by bacteria that produce it by chemically transforming the amino acid mimosine 1. In single stomached animals (horses, pigs, rabbits, etc.), mimosine causes hair to fall out. In cattle, the rumen micro-organisms transform it to DHP quickly; in sheep, this conversion is less efficient, but their rumen bacteria can adjust to a slow introduction of leucaena feeds.

Fear of mimosine's effects have for years been a barrier to leucaena's wider use as forage. Today, with better understanding of its pharmacology, much of this fear is being dispelled. Under field conditions, cattle with goiter don't die; the effects are reversible and can be seen early enough that the animals can be removed from the leucaena pasture to recover. Mimosine has no known effect on the meat or milk of ruminants that can be detrimental to humans. Nonetheless, mimosine is a concern, and searches are being made for low-mimosine varieties. The research in Australia has reached an advanced stage, and low-mimosine leucaena lines should be available for grazing trials in 2 years.

Cattle Performance. With their vigorous growth and high nutritive value, leucaena pastures can support heavy stocking, some of the highest carrying capacities of any tropical pastures. Interplanted with guinea grass, leucaena pastures often carry up to 2.5 cattle per ha (1 per acre). In favorable locations, leucaena/grass pastures (1:1 ratio) can support 6 or more steers per ha (2.5 per acre). The high carrying capacity continues into dry seasons longer than shallow-rooted forages, and with the rainy season's return, leucaena recovers rapidly so that animals can be restocked early.

Very high live-weight gains have been recorded in southeast Queensland. Young steers grazing a leucaena/Nandi-setaria pasture near Brisbane gained up to 1 kg (2.2 lb) per day during the main summer season. It has also been found that steers fed chopped sugar cane supplemented with leucaena can gain 0.6 kg (1.3 lb) per day. Given the pastures' heavy stocking rates and the animals' high weight gains, the amount of meat that can be produced on leucaena pasture in a high rainfall or irrigated area is impressive. Annual live-weight gains of 900 kg per ha (800 lb per acre) have been recorded in northern Australia. This is about double what is normally expected from good, tropical, grass or legume pastures. Dairy cattle also produce well on leucaena; in northern Australia, the annual production can be 5,000-6,000 liters (11,000-13,000 lb) of milk per ha. Fresh milk from leucaena-fed cows may have an objectionable odor. The odor disappears, however, on boiling or pasteurizing, and can be avoided entirely by eliminating leucaena from the animals' diets for 2 hours before milking.

Wood Products

The discovery of leucaena varieties that produce wood is timely and important. For forage, short, multibranched leucaena is used; but for lumber, pulp, paper, and fuel, the important varieties are of the Salvador type, which grow tall and have little branching. These varieties have several desirable characteristics including: rapid growth; adaptability to poor soils, drought, and windstorm; and high nitrogen-fixing capacity. But they do not have an aggressive, highly flowering, weedy nature.

In the Philippines, dense leucaena plantations have yielded higher annual quantities of wood than any species yet measured. Other fast-growing hardwoods (for example, Albizia falcataria, Gmelina arborea, Eucalyptus deglupta, and Anthocephalus chinesis) grow with annual increments of 28-43 m^3 per ha (355-545 ft^3 per acre) in the volume of wood they produce. Annual leucaena increments have been measured from 24 to over 100 m^3 per ha (300 to over 1,250 ft^3 per acre). Average annual increments are expected to be between 30 and 40 m^3 per ha (400-500 ft^3 per acre).

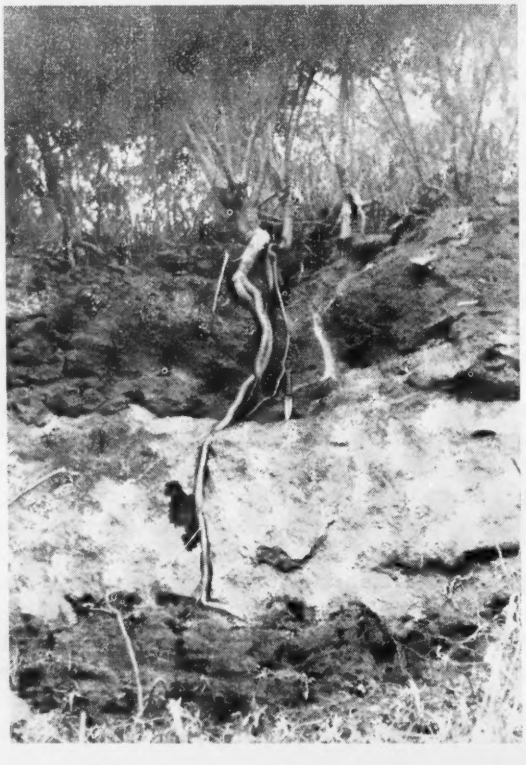
Although experience is limited, the trees seem to grow in 6-8 years to total heights of about 18 m (60 ft). Vigorous trees only 8 years old can have diameters of 21-37 cm (8-15 in.) at breast height. Unlike other leucaena varieties, the Salvador types tend to branch only at the top. Where soils are deep and growing conditions favorable, leucaena's rooting habits enable its planting in very dense stands. In the Philippines and Hawaii it is being planted in dense thickets that are selectively harvested for use as poles. Thinning the plantation in this way allows the remaining leucaena plants to thicken and grow so that their trunks become large enough for fence posts, telephone and power poles, and eventually for pulpwood and timber production. Wood from 6-8-year-old Salvador-type varieties has specific gravity averaging 0.54; fiber dimensions are typically those of a hardwood--it is a medium hardwood.

Pulp. Salvador-type leucaena wood pulps satisfactorily, producing both paper-grade and dissolving pulps with favorable properties. Preliminary tests suggest that compared with average Philippine hardwoods, leucaena wood can be pulped more easily. It is high in holocellulose and low in silica, ash, lignin, alcohol-benzene solubles, and hotwater solubles--all important benefits in pulp manufacture. Leucaena wood fiber is shorter than that of pinewood, but it falls within an acceptable range for pulp and paper, and the relationship between fiber length and fiber diameter is good for papermaking. Pulp yield is high (50-52 percent). The quality of the fiber and of leucaena pulp is comparable to that of other fast-growing hardwoods. Kraft pulp from leucaena is suited for use in printing and writing papers, but less suitable for high-strength bag and wrapping paper.

Lumber. Leucaena has a future as a source of lumber in the tropics. The wood is strong, dense, and attractive, and has easy-machining properties comparable to those of hardwood species now used for lumber and plywood. It seems likely that leucaena could become a source for mine timbers and railroad crossties (sleepers) as well as telecommunication and transmission poles.

Fuelwood. At least half of all the timber cut in the world still serves in its original role for humans--as fuel for cooking, and in colder mountain regions, home heating. With increasing deforestation and erosion of woodlands, firewood prices have risen even faster than kerosene prices. The logical response to this situation is to plant more firewood-producing trees, and for many areas Salvador-type leucaena varieties seem prime candidates. Leucaena is not adapted to truly arid or mountain areas, but it does grow well in semiarid and savannah regions of the dry tropics, as well as in more humid lowland tropics, where the need for firewood is very substantial. Growing leucaena either in plantations, or along roadsides, in shelter belts, on farms, and on unused land throughout rural areas could be one step toward relieving firewood scarcities.

Above: Dense stands of Salvador type leucaena have almost no lower growth or foliage; the plants are fairly fire-resistant.



Right: Strong, deep taproot of leucaena shown exposed on rocky ledge in Hawaii.

Because their wood is more dense, Hawaiian-type leucaena strains make better firewood than the Salvador-type, producing more heat when they burn. They are well-suited to small-scale village and household use. But the Salvador-type varieties grow faster and produce a greater quantity of wood, which (in addition to providing people with fuel for cooking and warmth) makes them suitable candidates for large-scale "energy plantations" grown specifically for fueling such things as: electricity generators; railroad locomotives; driers for fish, tobacco, grain etc.; facilities for processing cassava, sugar, rubber, or tannins from wattle bark; and tin smelters, brick and charcoal kilns, sawmills, etc. Heartwood increases as the tree matures, and leucaena's heating value improves with age, but it is thought that plantations can be harvested in cycles as short as 3-10 years. In the Philippines, three large corporations have embarked on planting thousands of hectares of leucaena for fuelwood; two will use it for standby electricity generation in case of fuel-oil shortages, and the other to produce charcoal. In Malawi, one Salvador-type variety is being grown as fuelwood for generating steam at a sugar factory.

Soil Improvements

Overgrazing, poorly controlled burning, and the careless removal of tree cover for timber or firewood are a misuse of forest resources which results in landslides, floods, soil erosion, and dried-up streams and rivers. To replace the vegetation cover, deep-rooted, quick-growing, adaptable trees and bushes like leucaena seem ideal. In a sense they provide a permanent mulch--a living mulch--that not only protects the terrain, but that (with care) can be continually cropped for useful products. Furthermore, under good soil and moisture conditions, one hectare of leucaena bushes cut to a height of 1 m (3 ft) every 3 months can provide foliage containing 500-600 kg (1,000-1,300 lb) of nitrogen in a year. In experiments, leucaena foliage was incorporated into soil around corn (maize) plants, and its ingredients encouraged such growth that the resulting corn yields were comparable to those in neighboring plots treated with mineral fertilizer. This process of "green manuring" also occurs, though more slowly, with the natural leaf-fall from uncut bushes.

Tropical temperatures, moist soil, and the small size of leucaena's leaflets encourage decay, and within 2 weeks the fallen leaves rot to form humus. Compared with inorganic fertilizers, the "slow" release of nutrients from decaying vegetation and microorganisms allows the crop a better chance to pick up the nutrients as they leach through the soil. Where fertilizer is unobtainable or too expensive, the leucaena system may prove attractive and practical. For example, Philippine coconut growers have found that leucaena makes a good green manure and browse crop that can be interplanted among the coconut palms.

TABLE 1. Fertilizer elements in dried leucaena foliage (including fine stems).

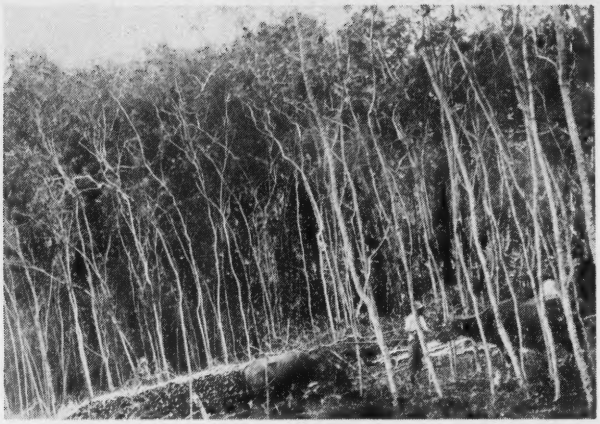
Nutrient Element	Percent of Dry Weight
Nitrogen	2.2 - 4.3
Phosphorus	0.2 - 0.4
Potassium	1.3 - 4.0
Calcium	0.8 - 2.0
Magnesium	0.4 - 1.0

Reforestation. Man has deforested one-third of South America's native forests, one-half of Africa's, and two-thirds of Southeast Asia's. In the tropics, the need is urgent to protect the remaining forest cover from further damage and to reforest the now-devastated areas. Most indigenous species take 50-70 years to mature; fast growing leguminous plants like leucaena are seen as a first line of defense. By providing an alternate source of forest products, leucaena plantations can reduce logging pressure on the forests, slowing the denudation that still continues.

Leucaena's fast aggressive growth and ability to thrive in poor soils make it a prime candidate for restoring forest cover to denuded hills and slopes. Leucaena can also pioneer the improvement of soil and growing conditions for other forest species. Leucaena can be interplanted with forest species: then, while it is enriching the soil--especially with nitrogen--it protects, shades, and suppresses the growth of vigorous grasses that otherwise stifle the young forest trees. In the Philippines young tropical hardwoods and dipterocarps interplanted with leucaena have shown growth increases of 50-100 percent. Eventually, the forest species can overtop the leucaena, dominate the plantation, and re-establish itself in the region. When the trees are well-established, the leucaena can be harvested for wood products. Leucaena is used this way in teak, rubber, and other tree plantations.

Removing the forest cover in the tropics rarely produces totally bare soil; all too often the precious forests are reduced to coarse grasslands of little economic value. These are difficult and costly to reclaim. The loss of forests to the tenacious grass Imperata cylindrica is a major problem in the Philippines, Indonesia, Papua New Guinea, and parts of Africa. This sharp-edged "cutting-grass" grows a dense network of roots and underground stems, crowding out other species and depriving them of moisture during the dry

Right: When leucaenas are planted in terraces using wood stakes, slopes as steep as 70°, not otherwise usable can be covered, and other crops can be interplanted. (Photo: M. D. Beuge)



Left: Leucaena converted this area from imperator grass to a productive firewood harvest; shown after 12 years. (Photo: R. L. Pendleton)

Right: Leucaena interplanted with traditional slash and burn crops in Papua New Guinea; nitrogen increased markedly in 2 years. (Photo: R. L. Parfitt)

seasons. Removing the grasses before planting a forest is impractical; they regenerate rapidly after the areas has been burned, and herbicide control is uneconomic. But, at least in some locations, leucaena can compete successfully and is one of the few plants that can do so. In the Philippines, planting has been done simply by burning the grass, opening a furrow with a plow pulled by a water buffalo, and dropping leucaena seeds into it. If tended carefully during the first few months, leucaena will grow to dominate and replace Imperata grassland. In about 3 years, there is a solid thicket of leucaena: the grass is dead.

Shifting Cultivation. Primitive man in the tropics based his livelihood on felling and burning a patch of forest, planting seeds in the ashes, and growing crops there until declining fertility and increasing pests forced him to fell a new forest patch. Today, the practice continues in hill regions of many developing countries. It has been much decried by foresters, for it wastes tree recources and exposes ground to erosion; but, since governments with limited funds have no substitutes to offer, traditions prevail. Indeed, shifting cultivation is increasing; year by year a greater amount of land is being cleared, and the time before farmers must return to a previously cropped area is lessening. There are believed to be 250 million slash-and-burn farmers worldwide, 100 million in Southeast Asia alone.

Papua New Guineans have integrated nitrogen fixation and soil building into their shifting-cultivation rotation. Before moving on, they plant casuarina trees or allow leucaena to reseed itself from the surrounding bush; both plants have Rhizobium-filled nodules and the soil nitrogen increases as they grow; then a deep leaf litter forms. Now, instead of waiting 10 years or more, the farmers can return to the leucaena-planted patches after only about 2 years, because during this time the percentage of nitrogen in the soil has increased adequately. Some researchers believe that leucaena planted densely along hillside contours may provide enough green manure to continually maintain soil fertility in the strips between, thus completely eliminating the need for cultivators to shift to find better soil. While reducing forest destruction, this method may reduce erosion at the cleared sites, provide income from leucaena products, and make a more sedentary way of life possible for shifting-cultivators.

[Extracted from Leucaena: Promising Forage and Tree Crop for the Tropics. Published by the National Academy of Sciences, Washington, D. C., 1977.]

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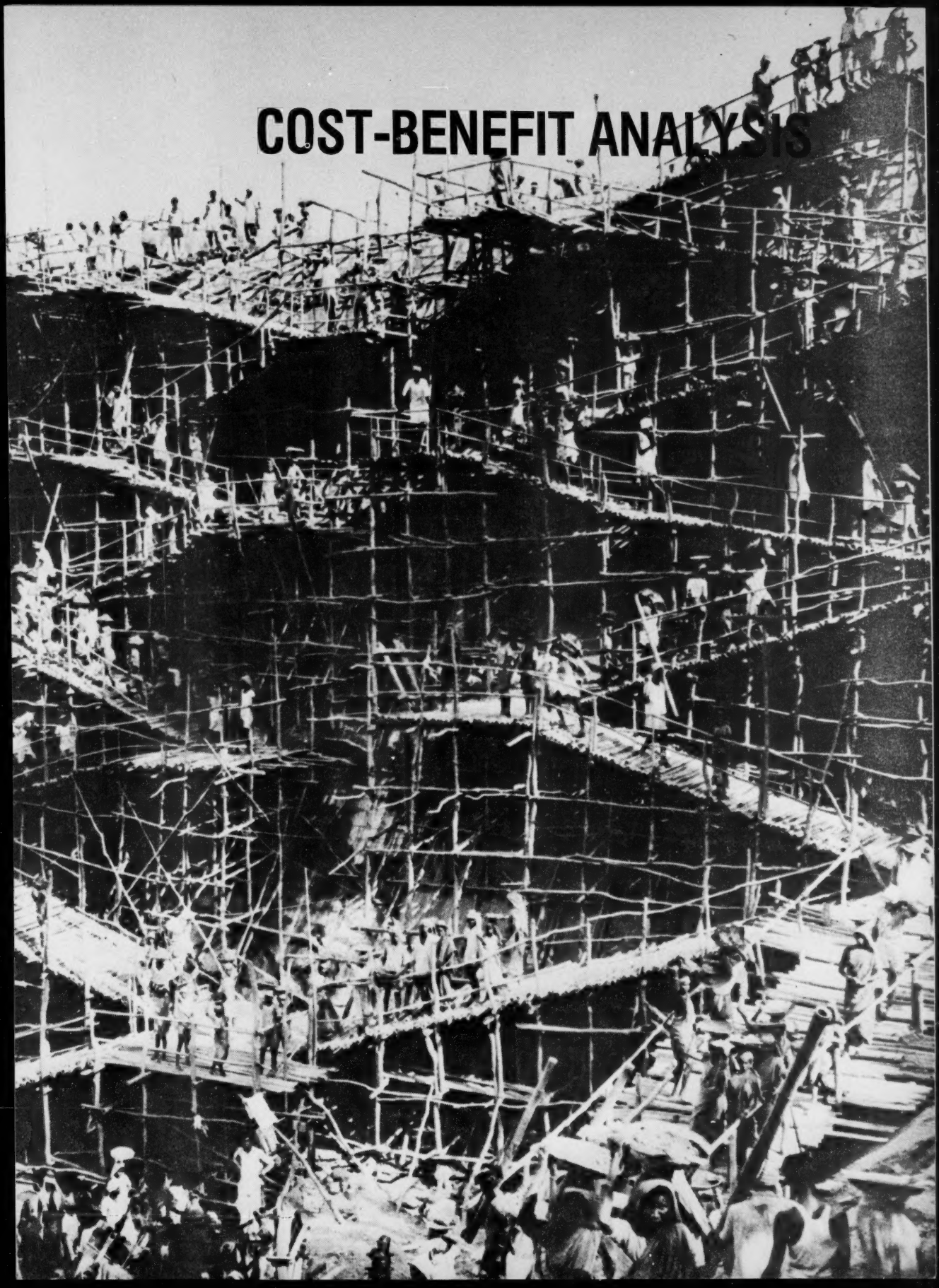
COST-BENEFIT ANALYSIS



THIS PICTURE OF THE CONSTRUCTION OF THE SHARAVATHI DAM IN KARNATAKA, INDIA IS TO SYMBOLIZE THE BUILDING OF AN ECONOMY BY COORDINATED CONTRIBUTIONS LEADING TO MAXIMUM GROWTH, AS GUIDED BY COST-BENEFIT ANALYSIS. (PHOTO: U.S. INFORMATION SERVICE)

Economic Analysis of Project Costs and Benefits: Some Problems of Adaption to Different Objectives

Gordon Donald

The purpose of this introductory statement is, first, to acquaint readers with the terminology and concepts of traditional cost-benefit analysis; and second, to present some of the issues currently being debated on whether national objectives other than economic growth should be incorporated into cost-benefit analysis, and if so how it should be done. The Development Digest of July, 1973 had three articles on this subject (pp. 3-40); this issue carries it into some new areas.

The starting point for a cost-benefit analysis is to estimate what a possible project will produce in the form of goods and incomes to its participants if it is carried out. Typically, one or several products are to be made and sold, and the various costs of producing them must be met; the difference between sales proceeds and costs will represent profit or loss. A financial analysis of a project consists in making the best estimates possible of the amounts of outputs that will be produced year by year over the lifetime of the project, and the prices at which they will sell, along with the amounts of required inputs--labor, materials, equipment, land and buildings (rented or bought), interest and repayments on any loans, etc. -- and their prices. This will, of course, involve guesses at conditions in future markets for both inputs and outputs, as well as a knowledge of the engineering relationships between inputs and outputs and some guesses at the levels of efficiency to be obtained in different years. The end result of a financial analysis is an estimated stream of profits and losses, one for each year of the project's life. This is the sort of thing a banker needs to judge if he is to lend to a businessman or farmer for a new venture: he must have some idea whether a prospective borrower can be expected to reach an eventual level of profits that will enable him to pay back the loan and still make an acceptable income from the new activity.

There are a number of problems involved in making such estimates. Clearly there is a lot of guesswork involved in estimating conditions in any kind of market in future years, and the further away from the present the more inexact any estimate will be. Price levels can vary;

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consumer tastes and incomes must be predicted; technology could change (alternative methods of production must be explored); foreign buyers and/or suppliers may be involved; and human performances on different levels can affect results. The government may or may not build a new road which will reduce transport costs; and so on. The value to put on land inputs is especially tricky in areas where land is almost never sold and is rented only to sharecroppers. There are conventional ways of dealing with these problems by making simplifying assumptions, and using standardized proxies or short-cuts; and experienced experts in relevant technologies can be consulted. Nevertheless it is well to remember, when one is exploring the higher levels of economic analysis, that the basic building blocks of the whole edifice erected on these estimated values are composed of what are often rather soft materials.

Judgments must be made on possible investments, however, whatever the uncertainties. Given the best estimates possible, organized for financial analysis, one must decide among alternative projects having different kinds of profit-loss streams. One project may yield high steady profits after several years, for example, but have very large initial costs; another involves very little initial red ink (i. e. years of loss) before it becomes profitable, but profits are low and soon taper down to zero; still another can be phased in without very large investment costs in any one year, and while early profits are low they will be rising high as the years pass. In short, one must compare not only magnitudes of profit/loss but different "time profiles."

This is done by converting all project-life values to a single present value for each project by using a discount rate. The present value of a future income (or cost) is reduced by a steady rate of discount for the passage of time, expressed as an annual percentage: if the discount rate is 10%, then $100 next year is worth $90 today, $100 two years ahead is worth $81 today, and so on. If each income total and cost total for a year (or the net profit or loss for the year) is reduced to present values by discounting, and these present values are added up, the total present values of projects with very different time characteristics can be compared by this single measure of overall profitability. The usual range of discount rates used for developing countries, e. g. by the World Bank, is from 8% to 15%. (It should also be noted that the discounting process can virtually eliminate problems of deciding on the length of "life" of a project of long duration, because discounted future values become insignificant after 25-30 years.)

The next step is to move from financial analysis to what is called "economic analysis." (This is a confusing use of words, I believe, because economists make all kinds of different analyses; but readers should be aware of how this specialized term is used in project appraisal.) Economic analysis is a method of estimating the gains and losses from a project to a nation as a whole, rather than to particular firms or indivi-

duals as in financial analysis. It is appropriate for project appraisal by governments or aid donors concerned with the development of a nation, as contrasted with a private banker or other lender concerned with private profitability of activities for his borrowers. A project's income and cost items are much the same as with financial analysis (except as noted later), but many of them are given different money values. Financial analysis always uses market prices; but these contain elements which should be eliminated or corrected in economic analysis (though the practitioners and theorists do not agree on all these differences, or how they should be handled).

Starting with some non-controversial items, it is conventional to eliminate elements in market prices which are attributable to government interventions in the economy in the form of taxes and subsidies. Thus, a product input incorporating a 10% excise tax will be valued at full market price in the accounting of financial analysis, but will be reduced by 10% for economic analysis; similarly, a subsidized input will be raised in value for economic analysis by the amount of the subsidy. The reason is that an economic analysis should be concerned with "real" resource use, that is: with the amounts of national resources used up in a project activity (the inputs) valued at their "true" cost; and with the value that is added to the national economy (i. e. the output) which the project produces with the use of these (input) resources. If the government taxes an input, e. g. a farm tractor, its price will rise by the amount of the tax; but the amount of real resources in it is still the same as without the tax. The tax payment merely transfers money from one party to another (e.g. input buyer to government to civil servant), which does not in itself use up or add to the real resources of the nation. In the same way, the payment of interest on loans is considered a transfer payment without resource change, as are dividend payments.

In economic analysis, the economic gains to the economy are called benefits, the costs are costs (as in financial analysis), and the difference could be termed social profit (this is not so widely used). The values used in economic analysis which differ from market prices are called shadow prices, or accounting prices. Another important concept used is that of pricing at opportunity cost: the prices of inputs used in projects being analyzed should reflect the value of what those inputs would be worth in other activities in the absence of the project, that is, the value of the opportunity lost by entering into the project. Sometimes it is difficult to know these values; but if, in the absence of a project, a manager earns salary $X in his job, or if a piece of land is rented for $Y, then X and Y are the values for opportunities foregone when the manager and land are transferred into the project, even if the actual salary and rental paid by the project are different. (The rationale for shadow pricing will be discussed further below.)

One area where shadow prices diverging quite a bit from market values are common is that of foreign exchange. When imported inputs

and/or exported outputs are combined in projects with domestic inputs and sales, the relations between foreign and domestic prices can be very consequential. In many countries the national currency is over-valued at official exchange rates for a variety of reasons. If so, it means that benefits of producing export products are valued too low in market prices of domestic currency; that real costs of imported inputs are also valued too low in domestic prices; and that projects which could do more for the economy by improving its balance of payments are made to appear less beneficial than they should in comparison with other projects having fewer exports or higher import costs. However, if one uses a devalued "shadow exchange rate" for project appraisal, this will produce project comparisons more in line with national economic interests. Shadow exchange rates can be applied to change the values of goods currently imported or exported, or extended to domestic products which might be traded internationally. (According to one school of thought, all goods and services should be translated into shadow prices reflecting international relative values--see Development Digest, July 1973, pp. 28-35).

Before going on to other, less settled ways of using shadow prices, a brief review of the methods of applying economic analysis to project selection is in order. Given streams of estimated benefits and costs to a nation, shadow-priced as appropriate, there are three principal measures which may be employed to find projects that will best serve national economic development. 1.) Maximum "social profit": the present (i. e. discounted) value of total project benefits minus present value of total costs. 2.) Benefit/Cost Ratio: present value of total benefits divided by present value of total costs. Both of these measures are affected by the choice of the discount rate: projects with relatively large initial costs or relatively long periods of waiting for net benefits to come through are favored by a low discount rate. They are rendered less positive (or more negative) by a high rate which, in effect, represents a short-run as opposed to a long-term outlook. 3.) The Internal Rate of Return is the discount rate which makes the present net worth of a project equal to zero. It represents, in effect, the average earning power of the money used in the project over the project life; the higher it is, the more profitable the project to the national economy. (This is cumbersome to calculate; one must go through all the annual benefits and costs with one after another discount rates, until finding which produces a net value closest to zero. Even then one does not get a precise answer, but in practical terms this is not necessary; if one can say it lies between two percentages, that is sufficient for use.)

When a number of possible projects have been processed in this way and one of them comes out ahead on one or more of these measures, it is well to look back over what was done in making the original estimates and consider how much difference it would make for project selection if the guesses or assumptions used were to be wrong. Suppose, for

example, one had been over-optimistic about the time it would take to complete a factory and get the machinery running, or about the ability of farmers to take up new practices efficiently, or about the quality of some land. (Optimism is much more often a cause of error than pessimism.) Sensitivity Analysis consists in changing particular items in the estimates and running them all the way through the analysis again to see how much difference this makes in the social profit, benefit/cost ratios, or rates of return. If the differences between projects are not very sensitive to changes in assumptions, i. e. if the final values are little affected by relatively large shifts in the pessimistic direction, then one may proceed with confidence. But if strong sensitivity emerges, then one must re-examine closely what the most realistically probable assumptions should be, and how a selection strategy can best allow for errors.

National Objectives and the Purposes of Economic Analysis

At this point we pause to consider what is accomplished if these cost-benefit procedures are followed by governments, international banks or aid donors in their selection of projects to finance. In principle, strict adherence to the numerical results of economic analysis of a wide range of projects that could be undertaken in a given country would bring about the maximum increases in gross national product (GNP) possible from given resources. If it should fail to do so, this would be because some superior projects had been omitted from consideration, or because the underlying estimates for the projects that were analyzed turned out to be faulty. But one can only make the best estimates possible in a condition of imperfect knowledge; and no alternative means of project choice could be expected to succeed any better in a reliable way. Economic analysis has been used for project selection by the World Bank, and increasingly by other aid donor organizations; in no case is it the sole criterion for selection, but the Bank in particular lays stress on detailed review of all cost and benefit estimates, and gives courses on how to prepare project analyses to Bank standards. Thus, there is wide and influential acceptance of the method and its purpose, not only to ensure that borrowers will invest productively and be better able to repay their loans but, more broadly, in the belief that a maximizing of economic growth is the best way to further national development objectives.

There have, however, been criticisms of the GNP as a criterion or measure of development, as well as criticisms of a reliance on cost-benefit analysis as the best way to ensure economic growth. To take up the latter first: one of the appeals of a cost-benefit approach to project selection is that it seems to provide neutral, impersonal judgments on the value of projects whose proponents are engaged in politicized competition with one another and are making a variety of claims and counterclaims that must be dealt with. And for many,

the use of exact numbers seems to carry extra authority when they purport to be true measures of pertinent facts. Useful as these numbers may be as administrative devices, they can also be misleading: competition among project proponents need not be confined to verbal gymnastics, but can extend into number games if it appears that important sums of money may be directed on a numerical basis. This could happen not only with a national government which used cost-benefit analysis to direct its investments, but even within a lending institution where there is competition among departments for funds.

Overoptimism expressed in numbers can stem, on the one hand, from honest faith in a project, and on the other hand from more cynical parties who see no reason to let a contract go elsewhere because of their failure to produce sufficiently positive estimates for future values--which nobody knows much about in any case. This problem is seldom mentioned in the literature. There has been criticism of the notion that investment decisions should be made from the numbers automatically. To this, proponents of the method reply that economic analysis is an aid to and not a substitute for decision making, that other aspects must of course be considered. However, they point out that the effort to measure costs and benefits forces decision makers to face up to the realities they should always be considering in project selection, that producing a numerical value in uncertain conditions is a kind of discipline which prevents project proponents from falling back on vague, evasive statements on the subject when they should work hard to define realistic probabilities as best they can. The discipline lies not only in the attention to realism, but in the logical, systematic organization of materials inherent in the method. Thus, they maintain that the requirement for presenting economic analyses has important benefits, even if predictions can be fallible and other project qualities must be considered in making final judgments.

Another kind of criticism of economic analysis as the path toward economic growth stems from the fact that a number of projects produce benefits which cannot be directly sold or quantified, yet are valuable and perhaps essential as indirect contributors to growth. Education projects would be a good example, birth control projects another. In both cases methods of defining benefits in measurable form have been devised, and money values assigned--e. g. to a high school degree, or a birth averted. But the relation between project inputs and the values allegedly produced for society is tenuous at best, and unconvincing to many. Nevertheless, the costs of producing specified (if unvalued) benefits can be examined in the interests of efficiency. This can help considerably in the use of resources within the sector. However, sector benefits relative to those of other sectors cannot be defined, and desirable levels of intra-sector investment cannot be formulated from clear economic guidelines.

Other types of costs or benefits that are not readily quantifiable, and tend to be left out of economic analyses, are the externalities of a project, that is, the effects it has outside its own boundaries. A farm project may increase local trade and land values in its vicinity, for example; or a factory may pollute a river with its waste. Environmentalists are especially concerned to see such considerations enter into project selection; they argue that pollution is just as much a cost to the nation as is an input used up in production. It is conceivable that some of these costs could be converted into money costs: a strip mine could be required to restore the land surface it used; a factory could be required to clean or bury its own wastes, or screen its smokestacks. These would then represent predictable costs that could enter into economic analysis. But some of the external impacts of projects are unlikely to be reducible to effective valuation as costs; and more types of impact are being discovered all the time. Indeed, the problem is one of deciding what "society" really wants: if clean air or water is a product of value, it can be purchased (jointly with other production), and cost-benefit analysis could accomodate its inclusion. Compilers of the value of GNP may have some definitional problems, which need not be insuperable.

A more fundamental criticism of economic analysis in project selection stems from a questioning of the validity of GNP growth as a measure or criterion of development. This is not the place to explore ramifications of this issue, some of which move away from economics into cultural or spiritual values. But one important area of complaint about the supremacy of the GNP criterion remains firmly in the economic sphere: the view that not merely the changes in total national income but aspects of its distribution should be considered as constituting national development. (See Development Digest, April 1973, pp. 109-124.) When a country's GNP grows rapidly but this growth accrues largely to the relatively rich, with the majority of poor falling behind or--with increasing numbers--suffering absolute decline in per capita income, then "development" may not be progressing. Projects which are selected to contribute most to further growth of GNP may be all too likely to continue favoring increases for the richer segments of society. Therefore, it can be argued, a way should be found for selecting projects that will be biased toward helping improve incomes of the poor. The problem of growing dualism --i. e. the growth of modernized, more urban, more wealthy sectors faster than the more traditional--is not universal, but it is in varying degrees sufficiently widespread in the developing world that the pertinence of this criticism is quite general. It must be noted that a concern for the poor in developing countries has been expressed not only by "radicals" but by many politicians in the developed countries, and strongly by the President of the World Bank which is perhaps the citadel of economic analysis. However, there is hardly a consensus on what should be done.

The way in which the criteria for project selection enter the debate on income distribution may be described as follows. International financial institutions, multilateral or bilateral, are concerned with best uses of their funds in developing countries; but they do not control the policies of borrower governments and can influence them only marginally and in areas pertinent to their function. The same kind of thing could be said of the economists and "technocrats" within developing countries who are not political leaders but who have some say about investment policies. Among some of the people in this position who are familiar with cost-benefit analysis, the idea has occured that they could contribute to upgrading the position of the poor in a systematic but not intrusive way by their influence on financial support for new projects. They might be able to adapt their cost-benefit measurements to reflect what they sincerely believe is a borrowing country's need, but without sacrificing the general economic efficiency purpose embodied in the analysis. This could be done in a kind of "technical" manner, quietly, without having to tell borrower governments how to make policy in their own countries nor upset existing institutions. Yet the result could, it is reasoned, be a slow but cumulative growth in the relative incomes of the poor because the new investments from that point on would be biased in this direction; and over time these new investments would come to constitute a larger and eventually a dominant part of the total structure of jobs in the economy.

There are several problems with this view. From the standpoint of policy makers, the injection of a bias in investments which had been introduced by external lenders, or quietly by their own technocrats, could be resented if it occured without their understanding. If they were informed, and briefed on the esoteric arts of cost-benefit manipulation, the objective could still lack appeal to the politically involved: either they do not really want redistribution of too much income (away from their friends, relatives, etc.), or they would like to see redistribution but find the method too slow and ineffectual. Indeed, the more radical opponents of the cost-benefit route to income redistribution assert that project decisions will not be much affected, and that those who put faith in the method are only supporting vested interests by ducking the "real" problem of a reordering of society by redistribution of property. If the method has political appeal, it would seem to be for non-revolutionary gradualists who are concerned with the poor. Whether it can be effective for its purpose, however, depends on how the purpose is defined and what devices will be used to serve it.

The intellectual problems involved may be as difficult as the political ones. The theoretical objective which shadow pricing is intended to implement is to define the relative values among resources (and thereby their combinations in projects) that would prevail in a

perfectly functioning economy. Traditionally this has meant under conditions of perfect competition (it could also be defined for socialism, but this is not usual). There are various kinds of deviation from perfect competition which have suggested corrections in the form of shadow prices: government taxes, subsidies and fixed prices (including official exchange rates) have been noted; monopoly pricing is another, and so are various impediments to the adjustment of wages and employment to the market. If low incomes are to be raised, it must be via employment in productive activity. The existence of unemployment (other than transitional between jobs) is in itself an indication of imperfection in the labor market. But the relationships between labor market imperfections and corrective shadow prices are poorly defined and controversial.

If a worker is unemployed, it is argued, then his opportunity cost for employment in a project is zero, and a zero shadow wage is appropriate. But can a project designer assume that all the same type of laborers on a project will have been unemployed? And that they would have remained so for the life of the project if there were no project? These two assumptions are rather extreme. In general, the virtues of low (but not zero) shadow wages in the presence of widespread unemployment and low-productivity street peddling can be defended: a pool of unskilled labor available in cities could be tapped without much loss of output elsewhere. (This would be less true, however, in rural areas where labor mobility is lower.) Use of low shadow wages for unskilled work would then tend to favor, to a greater degree, projects with larger proportions of unskilled labor costs in an inter-project comparison.

This is not a direct attack on unemployment, however. The employment generated in a project is not counted as a benefit but remains a cost, even though reduced in its shadow value, and the cost-benefit logic calls for minimizing costs per unit of output value. The cheapest way to create jobs is to devise make-work projects with little capital or material input, and often little value of product. But that runs counter to the economic efficiency drive of cost-benefit logic; and governments may not wish to ignore this logic even when they intend to alleviate unemployment, i. e. they do not wish to consciously waste their resources. So there is a conflict of two purposes, each with its logical imperative. One could simply set a very low shadow wage, disregarding the perfect-market criterion, in order to justify labor-intensive projects; but this would avoid, not solve the problem.

One approach to a solution is to segregate a portion of the economy, the problem area, and look for the most economically efficient activities within it. This is easiest to describe in geographic terms: for example, the most efficient projects in cost-benefit terms will be undertaken in a depressed region of the country, without considering

whether the pay-off from projects located in other more prosperous regions might be higher. This means, in effect, treating the region as if it were a national economy. Similarly, one could segregate functional areas of the economy for special attention, and seek the most cost-efficient projects which will: develop a mineral resource; produce a low-cost product (housing, clothing, or type of food) needed by the poor; or employ a certain category of labor. The conceptual problem is different in each case; they have in common that a national government has determined to give a certain category of activity a non-market priority, but relies on the economic analysis of alternatives within that priority area. (This is more like actual policy making in most cases than is the austere logic of relying entirely on economic analysis no matter where it leads.)

Still another approach to the problem envisages a rather extensive manipulation of shadow prices on the benefit rather than the cost side of the ledger. Instead of leaving benefits at market values, they will first be subdivided in accordance with estimates of the income levels of the anticipated project participants. Then the benefits going to the income groups one wants to favor (i. e. the poor) will be multiplied by coefficients to make them larger, while benefits for non-favored groups are treated with coefficients that reduce them. (Categories other than income level could be given this sort of treatment--backward ethnic groups, for example.) In this way a precisely graded definition of the relatively poor and worthy, as opposed to those less poor and less worthy of attention, could be introduced into project evaluation. This, it is suggested, would be the most finely discriminating and flexible approach to income redistribution within an efficiency framework.

Versions of this approach have been discussed in the literature but not, to my knowledge, applied to investment decisions. The method of altering the relative values of benefits by means of coefficients could also be used to differentiate more and less desired products as well as income recipients; for example, benefits from production of luxury goods for the rich could be downgraded while goods for the poor were upgraded. (It may be that these methods of rewarding sensitively defined gradations of virtue via shadow prices is probably more appealing to academic intellectuals or specialist planning departments than to politicians who must confront more directly the people that are being placed in ranked pigeon holes, and who may be called on to defend a particular ranking.) Certain ingenious methods of ranking by logical and numerical mechanisms have been considered, and these can be made to correspond to valid social purposes. This is perhaps the outer edge of a new intellectual endeavor, one which has been moving further from familiar forms of policy making and financial allocation.

Cost-benefit analysis seems clearly to be gaining wider acceptance and use in general. The use of shadow pricing is expanding, although many practitioners remain cautious and tend to discourage too much tinkering with market prices unless a clear case can be made to justify some particular shift. (It is the financial rather than the economic analysis, after all, that presents the reality of what will occur in a project--although the latter enters the "real world" when institutions like the World Bank use it for approving or rejecting investments.) But whether economic analysis can and should be employed for serving policy objectives other than economic growth is a much disputed subject. The specialist literature is accumulating, with some of it taking on almost a theological tone. People outside the specialist sphere may simply find the whole idea somewhat artificial, and resist the notion of being manipulated by numbers they either don't understand or don't have faith in; but opponents have not so far produced an alternative guide to action with anything like the same systematic logic and elegance of articulation. And the question of whether criteria of any kind for the selection of new investment projects are capable of serving as effective means of making a strong impression on income distribution, or reforming society, is one that awaits far more experience before it can be answered with assurance or discriminating detail.

The foregoing is intended to open some doors to a complex subject, not to cover it with any thoroughness. Readers who wish to pursue some of the newer variations may look into John Hansen, Guide to Practical Project Appraisal: Social Benefit-Cost Analysis in Developing Countries (United Nations, New York, 1978) which supplies useful references to the literature. Those who would like to know how to prepare economic analyses in more conventional ways (e.g. for World Bank project scrutiny) may consult J. Price Gittinger, Economic Analysis of Agricultural Projects (Johns Hopkins University Press, 1972; a new edition will be published in 1979); the methods described are applicable in non-agricultural projects also.

Cost-Effectiveness Analysis in Practice: A Domestic Water Supply Example

R. S. Porter and M. R. Walsh

[British aid policy calls for a large proportion of the program to go to the poorest people in the poorest countries. This case study illustrates ways in which project selection and appraisal can aid this aim for projects whose output is non-tradeable and non-marketed but which may often be important to a poverty-focused program. It attempts to demonstrate a framework by which such projects can consistently be examined, paying particular attention to their objectives, the nature of their beneficiaries, and the recurrent budgetary implications for the host Government.]

Project Appraisal in British Aid Policy

The change in emphasis in British aid policy announced in 1975 calls for a larger proportion of its program to go to the poorest countries, and for an increasing proportion of the various country programs to be used in ways likely to benefit directly the poorest people within those countries. The second aspect of the new policy--direct benefits for the poorest groups of the population--has implications both for project selection and appraisal. It is necessary to seek projects which will directly benefit the poor, and the appraisal methodology must at the least provide for the identification of beneficiaries so as to ensure that the projects we support are consistent with the British Government's policy.

The main emphasis of any development program aimed at the poorest must necessarily be to provide opportunities for more productive employment. It is by enhancing their capacity as producers that permanent benefits to the poor are most likely to be

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secured. Nevertheless their role as consumers cannot be ignored. In particular, there is some reason to believe that projects whose objectives are to provide better services, particularly in the fields of public health and education, are of special importance in a poverty-focused development strategy. It is evident that there is a relationship between consumption patterns and working capacity which emerges starkly when people are suffering from malnutrition. Increasing consumption of basic foodstuffs may be a necessary, though not sufficient, condition for improving the productivity of the poor. The same is doubtless true of programs designed to reduce the incidence of debilitating diseases through, for example, providing potable water and improved sanitation.

"Social" projects of this latter type raise particularly difficult problems in relation to project appraisal. The output is usually not marketed and is invariably non-tradeable internationally. The benefits are often exceedingly difficult to express in monetary terms. It is, of course, possible to say that the provision of a safe water supply will reduce the incidence of amoebic dysentery, or typhoid; that this will in turn reduce the number of days lost through illness; and that these days could, in theory, be valued. However, the chain of causation is indirect, the assumptions necessarily arbitrary, and the cost-benefit analysis then becomes an exercise of the imagination which can be both misleading and lacking in credibility.

Choices have to be made, and an analytical framework for project appraisal which enables the relevant information systematically and consistently to be deployed is essential. Our case study is designed to illustrate such a framework: the country and project which are described are fictitious, although we have drawn upon actual project appraisals carried out by the Ministry of Overseas Development during the past few years.

The starting point of our framework is the definition of objectives. In making such a definition, it is important not to prejudge the conclusion: for example, if the objective is to improve public health, a hospital building program is not necessarily the best way of doing it. There is little point in working out the least-cost hospital program when the appropriate solution lies in the field of preventive medicine.

Once the objectives have been defined, the next task is to identify the least-cost solution in terms of real resources; the familiar problems of shadow pricing are important in this connection. Of particular importance is the question of recurrent costs: for many projects of this type, it is either technically or politically difficult to recover from the consumers the costs of, for example, providing potable water in rural areas, and there may, indeed, be good social reasons why such services should be provided free of charge. However, nothing is free so far as society as a whole is concerned (apart from

grants from abroad), and the budgetary implications of such schemes need to be clearly spelt out. In quantitative terms the recurrent costs may often be of much greater significance than the capital costs, and even where schemes of this kind are being financed through foreign grants or concessional loans it is still of the utmost importance to explore the budgetary implications. Both donors and recipients have responsibilities in this connection. We are all familiar with the hospitals which stand idle through lack of a budget for the nurses, the roads which disintegrate through lack of resources to maintain them, and the water supply schemes which fail through lack of current maintenance. When the recurrent expenditure is basically current maintenance, external finance from donor countries for this purpose is not generally desirable because it leads to increasing aid dependence. Nevertheless, it would seem desirable for donors to satisfy themselves that the domestic budgetary implications of the schemes they are invited to finance have been fully analyzed and accepted by the host government.

The Project and the Development Context

The imaginary project area, Kurau, is situated in a remote area of one of the least developed countries of Africa, which has a GNP of $110 per capita. A new Five-Year Plan has recently been promulgated, with greater emphasis on the rural sector, agro-industry and supporting transport infrastructure, and to a lesser extent public health expenditure. (Note: the currency of this imaginary country is designated ~~M.~~)

Government Objectives in the Water Supply Sector. The provision of public health facilities and in particular the supply of potable water have been accorded low priority in previous planning documents. In 1975, for instance, capital expenditure for water supply was less than 4% of total public sector investment, and a large proportion of this was expended in the capital city. Less than 10% of the total population of the country, and only 3% of the rural population of the country, have access to suitable supplies of potable water (by comparison WHO estimates that 11% of the rural population of Africa as a whole have such access). The vast majority of the population obtain their domestic water from unprotected wells, streams and ponds. Many of these sources fail at the end of the dry season and water then has to be carried for long distances. Furthermore, the almost universally inadequate sanitary arrangements in rural areas cause unprotected water sources to be very liable to pollution. Evidence of this may be seen in the high incidence of water-borne diseases throughout the country.

The Government has decided to give greater priority to the sector and has set up a Water Authority which has assumed responsibilities formerly fragmented amongst several Government Departments. The Authority has begun to formulate a long-term water strategy and

policy, has instituted a training program for its staff at all levels with technical cooperation from several sources, and is in the process also of reforming the water tariff system, which up to now has been haphazard and has not generated enough funds to operate and maintain existing supplies.

The Development Plan provides for an investment program of M 160 millions with the object of providing access to potable water for at least 45% of the urban, and 15% of the rural, population during the period 1977-82. Technical criteria have also been laid down for rural water schemes, so that each supply should be technically as simple as possible and consist only of an intake or source system; the minimum amount of storage to ensure continuity of supply; and a basic distribution system. Designs are to be based on a per capita per day consumption of between 5 and 20 gallons depending on the complexity of the distribution systems and the number of individual house connections. House connections are only to be made where the full costs are paid by the householder.

The Project Area. The Kurau district consists of Kurau itself and four villages (see Figure 1). Kurau is situated on a flat alluvial plain about 10 km north of the Huda river, but is surrounded other than to the south by high rocky volcanic ground. The main crops of the district are barley, sorghum, and some fruits and vegetables together with livestock which are grazed on the hills. The two mountain villages of Aba and Bakoa are particularly dependent on semi-subsistence livestock rearing. The main sources of cash income are sales of fruit, a few small traditional industries such as tanning and shoe making in Kurau itself, and government administration in Kurau.

Population is distributed amongst the five settlements as shown in Table 1. The area has received an allocation of M 155,000 for water supply capital expenditure during the current planning period, which the authorities are not prepared to increase.

Table 1. Population of Kurau

	Total population	Households
Kurau	10,000	1,430
Duh	2,500	312
Bakoa	500	77
Kati	2,000	285
Aba	2,000	280
Total	17,000	2,384

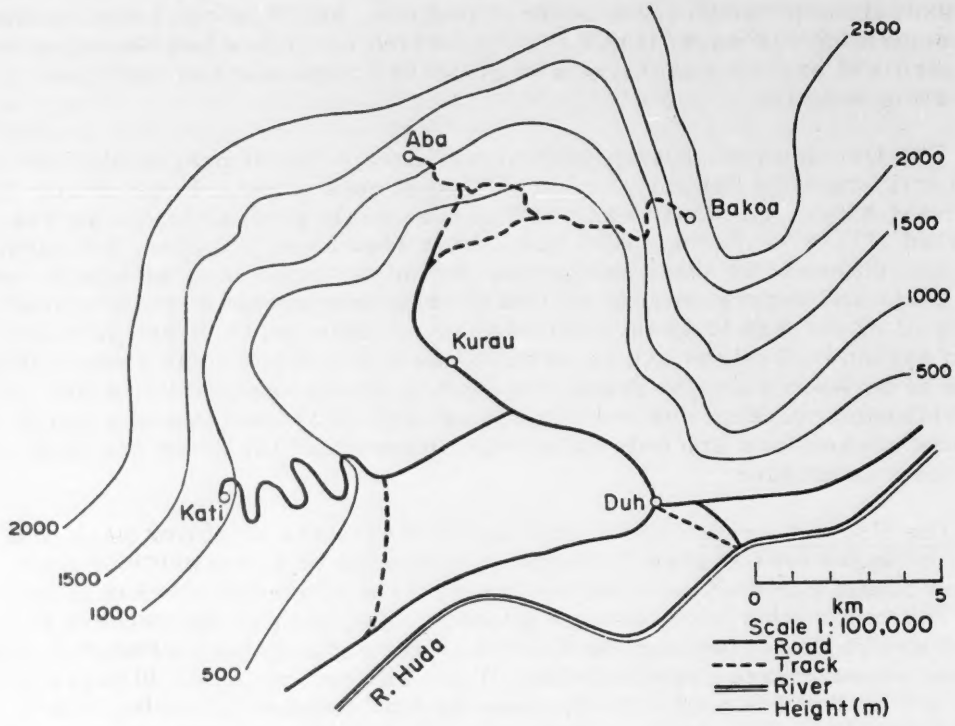

Figure 1. Kurau District.

Project Design. In Kurau itself, under normal conditions, domestic water supplies are obtained from shallow wells in and around the town. These are polluted, and during the dry season supplies from the wells are scarce; moreover, during the recent drought (and similar droughts in the past) the wells dried up completely for a period of several months and emergency arrangements had to be made for the town's water supply to be brought in by drawing untreated water from the river. Three hauling units with a total capacity of 2,000 gallons were making ten trips a day to provide a minimum supply, which was emptied into 44-gallon drums at the roadside and sold at a price of ~~M~~ 0.75 per gallon. Some free distribution was made to those unable to pay but this was haphazard and inefficiently organized. Recently the situation has improved, but the flow from the wells has not reached its former proportions. In Duh, the villagers also depend on shallow wells and during the drought were forced to walk about 2.5 km to the river to collect water.

All three of the outlying mountain villages, Aba, Bakoa, and Kati, depend by contrast on mountain springs and streams which are perennial, although flow is reduced in the dry season. In Aba, the stream is situated below the village, and in the dry season faecal and non-faecal pollutions are washed into the pools round the spring. Springs near all three villages are covered with stones but dogs, pigs, goats and sheep can easily reach such places. The villagers are not very careful about the use of streams and often wash and bathe upstream from the collection points of drinking and cooking water.

The consultants advising the Water Authority have proposed that in the two lowland settlements, boreholes should be drilled and water pumped to basic filtration and chlorination plants, and thence to standpipes located throughout the villages (Kurau and Duh). They have also estimated that there would be a demand in Kurau for fifteen individual connections to private houses and some institutions, e. g. the small government office and the school.

In Bakoa and Kati, the consultants recommend construction of small village dams and gravity-fed off-take systems leading to standpipes throughout the villages, and providing a minimum five gallons per head per day (ghd) throughout the year (more in the rainy season). In Aba, there is no suitable uphill source and they have proposed a pumped supply from the existing stream some 400 meters below the village. Storage for 24 hours has been allowed for and a distribution system similar to that of the other villages. The costs of these proposals are shown in Table 2. [Note: numerous details omitted here may be found in appendices to the original article.]

Table 2. *Summary of costs of consultants' proposals*

	Foreign Exchange		Local	Total
	$	M	M	M
Initial capital costs				
Kurau	28,900	38,533	16,270	54,803
Duh	12,410	16,547	5,820	22,367
Bakoa	7,600	10,133	10,450	20,583
Kati	10,000	13,333	22,500	35,833
Aba	12,000	16,000	22,900	38,900
Total	70,910	94,546	77,940	172,486
Annual operating and maintenance costs				
Kurau	1,445	1,927	26,150	28,077
Duh	620	827	10,650	11,477
Bakoa	50	67	40	107
Kati	150	200	120	320
Aba	250	333	12,220	12,553
Total	2,515	3,354	49,180	52,534

Construction of Accounting Prices

Conversion factors have been calculated in order to value local costs in opportunity cost terms at border prices. Shadow prices have not hitherto been employed by the national planning authorities, however, and calculation of rigorous conversion factors is difficult in the absence of detailed data and research. Domestic prices are distorted by import duties and quantitative restrictions on external trade, and by subsidization of some State enterprises producing manufactured goods. There is little doubt that domestic prices are out of line with world prices (i. e. border prices) at the ruling exchange rate.

Conversion Factors. The main non-traded good to be used in the project, other than unskilled labor, is transport, and a separate conversion factor has been calculated for this. All other non-traded inputs have been valued by use of a Standard Conversion Factor (SCF) calculated using the Squire/van der Tak formula:

$$SCF = \frac{M + X}{M(1 + tm) + X(1 - tx)}$$

where M = visible imports
X = visible exports
tm = ratio of import duties to total visible imports
tx = ratio of export duties to total visible exports

Application of this formula using 1974-75 data gives an SCF of 0.81. This corresponds reasonably well with the shadow foreign exchange rate of 1.3 used in recent appraisals by the World Bank.

Use was made of Ministry of Works data which gave a conversion factor of 0.88 for transport costs. For fuel costs, the market prices used by the consultants for each location have been adjusted for costs of domestic transport and distribution, and for excess profits being made by one distributor; conversion factors ranged from 0.70 in Aba to 0.82 in Kurau.

Shadow Wage Rate: Unskilled Labor. Calculation of the shadow wage rate raised particular difficulties, since little is known about the local labor market. There is clearly considerable underemployment in the area other than at harvesting time. It was assumed that construction can be phased to avoid this season. At other times of the year, loss of output from agricultural activities from which unskilled labor will be drawn will probably be negligible; the opportunity cost is therefore close to zero. However, additional nutrition to enable the labor force to carry out the work properly will be necessary, given the poor health and nutrition standards of the area.

The shadow wage rate formula used is thus

$$SWR = C - \frac{1}{S}(C-N)$$

where
- SWR = shadow wage at market prices
- C = project workers' wage
- N = additional nutrition required by the labor force
- S = social value of uncommitted public income relative to consumption

The SWR is calculated to be 0.83, and this in turn adjusted by the SCF gives an SWR at border prices of 0.67.

Shadow Wage Rate: Skilled Labor. Given the critical shortage of skilled workers in the economy and particularly in the rural sector, it was thought appropriate to apply a small premium to wages paid to this category of labor. This has--arbitrarily--been assumed to be 10% of the actual wage, and a conversion factor of 1.1 has been applied, which, multiplied by the SCF, gives a border value of 0.89.

Accounting Rate of Interest. It is difficult to say what rate of discount is appropriate. Loans to state enterprises have, after allowance is made for inflation, been made at about 8%, and this has been adopted as a proxy for the 'market-clearing' rate.

Other local costs, apart from fuel, have been treated as non-traded goods. This is justified by the knowledge that the bulk of the costs are for domestically-produced cement and locally-made bricks; but it may introduce minor errors into the analysis in so far as traded inputs are also an element of the total. It was necessary to value the resource costs of unpaid village labor, which it is intended should maintain the village dams. Since maintenance is a continuous process, this input was valued at the estimated marginal productivity in agriculture throughout the year, which, taking account of a three-month harvesting season, was estimated at M 100 per day, multiplied again by the SCF to obtain the border value.

Appraisal

Appraisal of the project is simplified by the absence of technical options for individual schemes. On the other hand, it is necessary to take account of the ceiling (M 155,000) imposed on its investment costs. Full implementation of the measures proposed by the consultants would exceed this amount. There are no other, cheaper, technical solutions that can be identified to meet the volume criteria laid down, and other methods of reducing costs such as reliance on

voluntary labor in construction of the schemes, or some of them, have been ruled out as experience has shown that own-labor schemes are not successful in terms of achieving objectives, at least within a reasonable time span. For these reasons, one of the villages must be dropped from the project for the time being, to bring the overall cost within the limit set by the government.

As a first test, the Development Plan's criterion of lowest capital cost per head was considered. Table 3 shows this at financial and border prices.

Table 3. Capital Costs Per Head

Village	Financial cost -M-	per head	Cost at border prices -M-	per head
Kurau	54,803	5.48	51,611	5.16
Duh	22,367	8.95	21,311	8.52
Bakoa	20,583	41.17	18,025	36.05
Kati	35,833	17.92	29,694	14.85
Aba	38,900	19.45	32,659	16.33

At financial prices, the two plains settlements, Kurau and Duh, are significantly cheaper than the mountain villages; in border prices, the ranking is unchanged although the differences are less, reflecting the more labor-intensive type of schemes in the latter. In both cases, the smallest mountain village, Bakoa, is the most expensive. However, when recurrent costs are taken into account, the capital cost test is shown to give misleading results. The present cost of the schemes at financial and border prices, using the 8% discount rate, are summarized in Table 4.

Table 4. Capital Costs Plus Discounted Recurrent Costs

Village	Financial cost -M-	per head	Cost at border prices -M-	per head
Kurau	332,086	33.2	283,648	28.4
Duh	137,683	55.1	112,209	44.9
Bakoa	21,611	43.2	21,578	43.2
Kati	38,956	19.5	35,187	17.6
Aba	160,954	80.5	122,690	61.3

A sensitivity analysis was conducted to test these results against:

- a 20% increase in the costs of imported equipment;
- a 20% increase (decrease) in operating and maintenance costs, other than fuel;
- a 10% increase (decrease) in fuel costs;
- shadow wage rates of 0.75, 0.50 and 0 as opposed to 0.67;
- no premium on skilled labor.

These items cover all the major project inputs. The more extensive sensitivity analysis given to the shadow wage reflects relative uncertainties both as to its accuracy and as to the distributional aspects of the project, which are discussed below. As it turns out, however, the costs of the schemes are more sensitive to changes in the costs of the two traded goods, equipment and fuel, than to the non-traded inputs (see Table 5). However, no plausible combination of changes in assumptions would alter the ranking of Aba as the most expensive scheme in per capita terms; it was not therefore necessary to try to assign probabilities to the changes in the assumptions to conduct a risk analysis, by calculating expected costs.

Table 5. *Sensitivity analysis*
(M)

	Kurau	Duh	Bakoa	Kati	Aba
Effect on present cost of:					
20% increase in costs of imported equipment	+9237	+4942	+2027	+2667	+3500
20% increase (decrease) in operating and maintenance costs other than fuel	±5503	±2606	±711	±1099	±1525
10% increase (decrease) in cost of fuel	±19687	±7091	–	–	±8067
Shadow wage rate of: 0.75	+721	+281	+722	+1515	+1547
0.50	–4489	–1760	–6120	–9470	–9495
0.00	–8978	–3521	–12241	–18941	–18991
No premium on skilled labour	–860	–411	–104	–147	–232

From the viewpoint of costs only, and ignoring the ability and willingness of recipients to pay for potable water supplies, and also assuming that the benefits to each household are identical: then it is obvious that the gravity-fed systems which require little maintenance have a low present cost, as opposed to those where pumping is required as at Aba and Duh. This is not however the case at Kurau, where economies of scale in water provision are significant. However it may not be justifiable to ignore the factors listed above and it is necessary to investigate in greater detail the nature of the benefits of the project, and its beneficiaries.

Water Charges. The starting point for such an investigation is to ask what the population of each village would be prepared to pay for the water, and to compare this with a water tariff which fully covers the operating and maintenance costs of the scheme, and gives an 8% return (at nominal prices) on capital invested by the Water Authority. Such a tariff has been worked out by the consultants, showing the necessary charges per gallon assuming consumption of 5 ghd from standpipes and 40 ghd from individual connections (and assuming equalized repayments of interest and principal over 20 years). This tariff, and the annual implied household expenditure, are shown in Table 6. These tariffs compare with an estimated income per household in the area of ₥ 455 (₥ 65 per capita). While it is obvious that these charges are, in the main, well beyond the financial means of the population, it is equally obvious from casual observation in the area that incomes are very unevenly distributed, and some Kurau households could undoubtedly afford to pay a full standpipe charge.

Table 6. *Cost-recovering water tariffs, and annual implied household expenditures (₥)*

Village	Cost per gallon	Annual implied household expenditure
Kurau		
Standpipes	0.0018	22.97
Individual connections	0.0022	224.52
Duh	0.0030	43.87
Bakoa	0.0024	28.44
Kati	0.0011	14.09
Aba	0.0045	58.66

Moreover, it is commonly recognized that there are benefits to be imputed to projects of this character beyond those that can readily be measured in quantitative terms. The concept of consumer surplus has to be considered, that is, the extent to which some of the richest households in Kurau would be prepared to pay more for water than they would be asked to do at this level of charges. It is arguable in particular that those sections of the population who can afford a private connection would be prepared to pay higher prices for the volume of water they will consume, and indeed during the drought these consumers were prepared to pay very large sums (₥ 0.75 per gallon) for water brought in from the River Huda, 9 km away.

The unquantifiable benefits of the projects will also include reduction of water-borne diseases and hence better health; and time-savings, as villagers will no longer have to walk long distances to fetch water. As explained above, it is not considered that these benefits can be realistically valued.

Some valuation can however be made, in crude terms, of the consumer surplus for those who will have individual connections by reference to the amount that they were prepared to pay during the drought, although the crude difference between the drought rate and the cost-recovering rate of Table 6 applies only to the premium payable for minimum life-sustaining quantities rather than the marginal additional gallon of normal usage. Nevertheless, it seems appropriate to recover some of the consumer surplus of those with the direct connections, and it is proposed to charge 1.5 times the tariff calculated by the consultants. As regards the standpipe users, there are marked variations in income also, but it does not seem possible to charge differential rates directly to households; some of the benefit of the necessary subsidy will, inevitably, be captured by better-off groups. An alternative is to make no direct charge for the use of standpipes, but to make payments to the Water Authority from local taxation: this would have the advantage of some progressitivity in payment, but would reduce the direct connection between water use and charges, which is likely to encourage waste. In any case, it was possible to foresee administrative complications in adopting such a procedure, and it was not therefore pursued. If however, a flat individual household charge is to be levied, then it must be geared to the ability of the poorest households to find the fees. This issue is taken up below.

Lastly, the distribution of the benefits of the project must be considered. As with many of the countries where projects are financed with UK aid, statistics are almost completely absent. If, however, the national distribution of income, shown in Table 7, can be taken as being representative of the distribution in Kurau, then at least 60% of households in the area would come into an income band below ~~M~~ 120. Since observation suggests that income distribution in Kurau is, if anything, more skewed than that of the country as a whole, it can safely be assumed that at least 70% of the beneficiaries of the project will be amongst the lowest income groups of the country.

The proposed scheme at Aba has the highest present cost per capita in both financial and economic terms and, as is evident from Table 8 in the next section, would also require the largest subsidy in per capita terms. Although it could be argued that it is probably poorer than the plains' villages, and has the most

Table 7. *Income distribution*

Income ₦	Percentage of population with incomes in range	
	Individual	Cumulative
0 – 30	4	4
30 – 60	18	22
60 – 120	46	68
120 – 240	14	82
240 – 480	11	93
480 – 960	4	97
960 – 3840	1	98
Over 3840	2	100

Note: *National figures of income distribution for 1970-71 have been adjusted for inflation since then. 68% of the population have a disposable income of less than ₦120, which is close to the mean, ₦117. If a similar proportion of the Kurau population are below the district mean, ₦65, then in national terms they fall into the two poorest categories (22%) of the population of the country as a whole.

polluted source at present, it is not thought that these considerations outweigh the additional costs involved. It has been agreed with the Water Authority that this part of the overall scheme be dropped, owing to the financial ceilings imposed on the project.

Recurrent Financial Implications

It was argued above that users of direct connections should be both able and willing to pay greater amounts for the water supplied to them than that necessary to fully recover costs (including the capital investment); one-and-a-half times that rate was calculated (see Table 8). It was also argued that charges for houses with access to standpipes must be geared to the ability of the poorest households to pay. It is now suggested that initially these charges should be set at ₦ 10.00 per household per year, which would represent just under 2.5% of total expenditure for a household with an income of ₦ 420 per year (a higher proportion of cash as opposed to total, including non-monetary, income). This also (Table 8) enables recovery of two-thirds of the operating and maintenance costs of the schemes in the first years. The cross-subsidy from direct connection users to other households is equivalent to ₦ 1684 per annum. It is hoped that with other planned income-

producing projects in the area, real tariff levels can gradually be increased so that the schemes can become self-financing and then generate a surplus for capital renewal in these schemes and investment elsewhere by the Water Authority.

Table 8. *Financial implications of the schemes*

Village	Operating and maintenance costs	Revenue
Kurau		
Standpipes	28,077	14,150
Connections		5,052
Duh	11,477	3,120
Bakoa	107	770
Kati	320	2,850
Total	39,981	25,942
Aba	12,553	2,800

Conclusions

It is in our view incorrect to draw the conclusion that project appraisal is not useful where schemes with non-marketed, non-tradeable outputs are concerned. The analytical framework should enable the information available, which is seldom more comprehensive in practice than that shown above, to be deployed systematically.

In the case of this project, the objectives--of providing at least a minimum supply of water to stated proportions of the population--can fairly easily be met: 87% of the population of the district will be so supplied. Clearly, progress toward the national targets will depend on replication of this type of scheme over a wide area. In this particular project no technical options were available, so that the technical cost-effectiveness of each village scheme could only be judged in general terms, e. g. by reference to projects in similar circumstances elsewhere. The analysis does show up, however, the dangers of crude and partial indicators--such as capital cost per head--as possibly misleading where choices have to be made, as in this case by the elimination of one village to accommodate an investment ceiling. In other areas this kind of analysis might apply to consideration of alternative ways of supplying water in each place.

The use of shadow pricing does not, in this case, alter the rankings of the schemes. Table 4 makes this clear. Nevertheless, we cannot be certain until the shadow prices have been worked all the all the way through that their application will not lead to a different set of decisions from those that would have been taken if they were not

used. These conversion factors can be used for other project studies in the country concerned; and this specific type of investment is one that will be repeated many times by the Water Authority. As the alternative means of providing rural water supplies are likely to be fairly limited, the results of this and similar analyses, once undertaken, may provide useful rules of thumb for deciding how to design similar projects elsewhere without a lot of new appraisal work. However, it is necessary to urge some caution in recommending such rules of thumb: the useful factors are the pattern of the analysis and the way in which the conversion factors are applied, rather than the conclusion that supply systems similar to that at Aba should be avoided. We would hope in this type of situation that future designers of schemes would carry out a similar analysis and use the conversion factors which now exist.

Lastly, the analysis brings out, albeit in a crude fashion, the impact of the project on different groups of beneficiaries. With the typically rudimentary (and often unreliable) information which is available it may often not be possible to do much more than to point out, as in this case, that a project to which all social groups have access will give substantial benefits to poor people. For this to be the case, it must be established that access is in fact possible for all groups. In the case of water supplies to villages this is rather easier to ascertain than it would be if populations are very dispersed, or in other sectors such as health or education services. Careful identification is also necessary of the ability and/or willingness of recipients to pay so as to ensure that the recurrent costs will be met; or if this is not possible or desired, that the domestic budgetary implications of schemes have been fully analyzed and accepted by the host government.

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Cost-Benefit Analysis and Income Distribution

Galal A. Amin

[A Symposium was held in Kuwait in April, 1977 by the Kuwait Fund for Arab Economic Development, which by then had advanced $1.4 billion to 40 countries (including non-Arab recipients), and had been concerned with questions of project appraisal. Jointly with the Institute of Development at the University of Sussex, England, the Symposium focused on methods of adapting cost-benefit analysis to the effort to help low-income people in aid-recipient countries. Some highlights of these discussions are presented.]

Participants in the Kuwait Fund Symposium included at least as many persons who were directly involved in the everyday activities of project appraisal as "pure" academicians. (Names of participants are underlined in the text; they are identified at the end of the article.) The discussion had a realistic bent often absent from the academic seminars. Practical problems and non-economic factors were brought in and emphasized, and the experiences of the practitioners, some of whom occupied prominent positions in their countries, could be related to the more abstract views of some economists. This summary of the more controversial points made in the discussion allows the reader a closer view of the standpoints of both academics and practitioners which are seldom explicit in their writing. Readers may thereby come to appreciate more fully the difficulties which the project evaluator, like the aid donor, continuously meets in practice.

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The Income Distribution Objective in Cost-Benefit Analysis

There was some debate as to whether there was any need to incorporate distribution objectives in cost-benefit analysis. Some participants denied the existence of a conflict between growth and equity. It was argued that raising the incomes of the poor through employment-generating projects was as likely to contribute to economic growth as more conventional kinds of projects. A conflict between them might exist in the very short run but not over a longer period of time, and might have existed during the earlier experiences of rapid economic growth but not in the present conditions of developing countries. In the absence of conflict between growth and equity, there would be no point in incorporating distribution objectives in cost-benefit analysis. But this view seemed implausible to some participants. James Mirrlees said that there were many projects which would probably be worth implementing because they would raise the incomes of very poor people in very poor regions but which would hardly contribute to growth at all. He pointed out that the purpose of investment appraisal was to try to see what was possible, and to provide guidance for choice among the various possibilities rather than to state certain employment or income-distribution objectives while disregarding what can actually be achieved.

Zakaria Nasr saw no point in transforming project appraisal into a tool for social reform, unless a consensus is reached on the need to sacrifice efficiency for all sorts of other objectives such as more equity, more workers' participation, less urban concentration or more women's liberation. "We should not be awed by the current insistence of so many eminent economists on equity, distributional objectives, basic needs and similar fashionable concepts. This fashion, like other fashions in development economics, will pass." What the LDCs are really after is not essentially the alleviation of the present poverty of their lowest strata, nor are they on the quest for some abstract and elusive concept of equality and justice for present generations. They are fundamentally after cultural renaissance--concretely, especially in terms of the international equivalence of economic status and relative power. And the only road to this is simply growth, old fashioned and straightforward GNP growth. Naturally, this implies growth with all the other requisites of development and modernization, growth as fast as possible, as socially possible.

Aftab Khan denied that anything very significant could be done towards the employment and income-distribution objectives if one were to consider one single project only. For this purpose, the entire socio-economic policies and programs of the government have to be considered. Poverty-focused strategies, no doubt,

have to depend for meaningful results upon specific investment projects aiming at providing opportunities for gainful employment and at raising incomes of particular target groups. Experience of many developing countries, however, revealed that such projects often turn out to be inadequately productive and generally are of a "make work" variety.

Robert Porter commented on a question as to why one should go through all the effort and problems of shadow pricing when it should have been possible for the government to get the prices right through some kind of administrative fiat. The fact is that the structure of relative prices at any particular time is the result of complex economic and political factors, of historical situations, and of past policies which are very difficult for the government to change even if it wanted to. To take India as an example, a certain line of policy, followed for many years, has created a price structure which is very much divorced from the structure of international prices. The government itself realizes that it is unsatisfactory, but if it were to be suddenly abolished terrible social problems would be created and whole industries would go bankrupt. The rationale of the shadow prices approach is that incremental decisions, i. e. decisions affecting new investments, would allow the policy-maker to push investments in the right directions so that the whole apparatus can be gradually dismantled; but it is very misleading to suppose that one can by administrative means get shadow prices to be the actual ones. The same principle applies to income distribution. The income distribution pattern in any particular country is also the product of historical development, of power struggle, etc. It is simply unrealistic to suppose that a government, even if it wishes and even if it has the political power, could alter income distribution in a very radical way by fiscal or other means of macro-economic policy. Attempts to do so usually result in a very dramatic loss of output which affects everyone. Therefore, let us do all we can on the taxation and fiscal side; but in our investment program, as we are developing the economy, we should try to move the economy in a particular direction. The particular ways in which the productive process is developed can itself contribute to income distribution objectives.

Frances Stewart said that it was not easy to change the structure of prices, but the same reasons which made it extremely difficult to change prices also applied to attempts to make social cost-benefit analysis effective in dealing with the distribution issue. There were very strong political forces, in some countries, against effective income redistribution. Similarly there were strong forces that prevented changes in prices, as for example those opposed to moving away from a heavily protected system to a more export-oriented one. She suspected that once there was a major impact on income

distribution, the project selection method would also be subject to the same political forces which prevented direct change through the tax system. This was why she was dubious about the possibility of making any significant impact on income distribution through social cost-benefit analysis.

Apart from the scarcity of data and the unquantifiability of many variables, a formidable difficulty in incorporating distribution considerations is that of deciding what distribution weights to use. Aftab Khan said that to try to derive such weights from government policies was pointless, since very few governments knew precisely what their objectives ought to be. "Having been associated with many plans in a number of countries, I found that nearly all plans articulated [a wide range of] objectives. . . It is well known that these objectives are not necessarily compatible. Ideally, if more than one objective is set, it is also necessary to lay down the limits which each imposes on the other so that clear and precise criteria for investment decisions can be established in the light of a single preference function. This theoretical ideal, however, is not realized in any plan. The members of the government as well as the planners are generally non-plussed when questioned about "trade-offs" between conflicting objectives." Nasir Khan added that objectives also changed from government to government in the same country, which was particularly relevant if the project's life was very long, say the building of a dam which lasted for 50 years. "Whose objectives are we then to adopt? And how are we to discover them?"

More Common Sense or More Rigorous Analysis?

Z. Nasr suggested: "We should try to devise operational methods corresponding to the data available, and to the statistical capabilities of most developing countries. This is not to say that 'simple is practical', or that appraisal techniques should always be within the reach of the most backward economic manpower. The need for an 'appropriate technology' should apply to techniques of analysis only when the nature of the data available so requires, not as an excuse for making do with 'pidgin' appraisal reports." It was necessary to translate the sophistication of theoretical analysis into practical formulas into which available data could be fed; it seemed unlikely that we should ever have the information required to pursue the ramifications of a general equilibrium system or the models of optimal public policy.

In the view of the scarcity of data and of the fact that important factors affecting the appraisal of projects cannot be quantified, complex mathematical models, such as those suggested by Mirrlees were thought by some participants to be of little use for under-

developed countries. Galal Amin argued that for these reasons, common sense could often be a better guide in project selection and evaluation than sophisticated models of cost-benefit analysis. To wait until underdeveloped countries improve their data collection amounts to waiting until they become developed.

Abdel-Rahim Merghany wondered whether such projects as those providing water or health services should be subjected to cost-benefit analysis at all. Robert Chambers questioned the need for elaborate perfectionism when common sense often led one to the same conclusion as did cost-benefit analysis. Insistence on elaborate analysis when the right decision is obvious could only delay action and hence do more harm than good. He said, "God forbid that resettling Africans on European land in Rhodesia should be delayed by elaborate procedures of this sort because the cost could be enormous in terms of human suffering." We tended to equate sophistication with complexity when we should be thinking of optimal procedures, and consider as sophisticated whatever was optimal. True sophistication might lie in seeing ways in which one could simplify, or short-circuit a long route by adopting a much shorter and simpler plan.

Abdlatif Al-Hamad said that elaborate cost-benefit analysis was not of much help to the decision-maker in certain cases, such as on whether to build a certain road in a country like Mauritania where there were hardly any figures on the volume of traffic or trade between the various parts of the country which the road would help to connect. Common sense would tell you, however, that the road should be built since if it was not the country might break apart. The interior of the country was trading with neighboring regions, while the outer parts were trading with the outside world with little connection between the two. The two parts of the country were virtually two separate countries.

J. Mirrlees said that while he did not believe that one should rely totally on calculation, he found the word judgment awkward and misleading because of its ambiguity. "Things in economics are not by any means as obvious as they look. Things which might appear to the romantic impulse to be extremely valuable might turn out to have had very little effect, or to have been excessively costly as compared to benefits. This might be less likely to happen in, say, water supply projects where sanitary engineers had accumulated a lot of knowledge. But even in irrigation projects, of which engineers also know quite a lot, dams might well have been constructed differently if economists had been prepared to get down to discussing details with the engineers, with the principles of economic evaluation at the back of their minds and if possible on their pads in front of them."

John MacArthur said that he was very mistrustful of that thing referred to as "common sense" or "judgment" if it was not the result of a systematic consideration of issues which were relevant to the decision we wanted to reach. Much of the criticism of cost-benefit analysis was simply the result of a misinterpretation of its role. This role was to illuminate the decision, not to make the decision itself. It would be arrogant of any economist to believe that he could really produce the decision by calculation. Decision-making was a separate function. The economist could only hope, by bringing in all the considerations that he could possibly lay his hand on, to help the decision-maker to take a better decision than would otherwise have been the case. It was also wrong to conceive of project evaluation as simply one stage in project planning. Cost-benefit analysis should be at work right from the time the project idea was conceived, rather than brought into play after the engineers had made their design, since there was little chance of getting anything changed after that was done. The function of cost-benefit analysis was not simply to provide one final figure for a rate of return. One had to look at the origin of the figure, to try to take some view of the distribution of which this figure was the central value, and to raise all the relevant questions about objectives, externalities and uncertainties. One of the principal benefits from cost-benefit analysis was not the numbers at the end but the external benefits of having gone through the process of asking questions that cost-benefit analysis raised, and addressing oneself distinctly to the issues that had to be tackled.

R. Porter said that although many investment decisions were taken on political or non-economic grounds, the role of the economist was to point out precisely what the costs of such decisions were. The history of both his own country as well as that of developing countries was full of examples of bad investment decisions, of an enormous misuse of capital largely because people did not ask the right questions.

Ibrahim H. Abdel Rahman said he could not see why one should contrast common sense with analysis. One had to make use of both. There was good and bad analysis just as there was good and bad judgment.

G Amin said that if common sense or intuition had ceased to be regarded as respectiable terms, it was because we had become too fascinated and obsessed by quantification. In fact, their use in project evaluation could be more scientific and more rational than numerical calculations. "Common sense refers to a store of information which men collect through their various experiences but which is very difficult to spell out, let alone quantify. If you are driving a car and are suddenly faced with another car coming in the

opposite direction and with the danger of a crash, you would be ill advised to follow what seems to be MacArthur's or Mirrlees' advice that before taking any decision, you have to try to measure the width of the road, the distance between the two cars. . etc. Since there is no time and no possibility of measuring all the possible variables that could affect the outcome, you are better advised to make a quick judgment on the basis of your stored information and knowledge about the width of the road, the distance, the likelihood of the other driver being drunk and a large number of other factors with which you may have had some experience. Your estimates would by no means be unscientific, they would only be rough; and to make them may be the only way of avoiding danger. What is unscientific as well as contrary to common sense would be to follow the recommendations of "rigorous" cost-benefit analysis: for taking government values as if they were the values of the whole society; for refusing to make use of a concept like "dualism" simply because it is not sufficiently exact; for adopting distribution weights whereby the value of an additional pound to the poor is said to be worth so many additional pounds to the rich. This is not science but pseudo-science. No one can deny the rationality behind comparing costs and benefits; but those who are making the exercise of social cost-benefit analysis are often not doing what they are pretending to do. They are alleging that they are trying to discover something related to the society as a whole when they are really comparing some costs and benefits which happen to be measurable."

R. Chambers said that the right question to ask was whether the procedures of the cost-benefit method made it easier or harder, more or less effective, for those carrying out project appraisal to meet the new objectives. It is possible that we have reached a stage where, because of this shift in objectives, one should start again from scratch. If one adds employment and income distribution criteria to a well-established procedure, one is liable to make these criteria less central in the decision-making process than one might wish. Perhaps what was needed was to alter the sequence of questions so that at a very early stage, the main question to ask should be: who benefits?

Project Identification, Appraisal and Implementation

In a discussion of the role of cost-benefit analysis in the whole process of project selection, R. Chambers criticized economists for devoting too much of their time to project appraisal to the neglect of other stages in the project's life. He quoted a recent study examining the operations of the World Bank in which 36 different activities in the life of the project had been identified, of which project appraisal of the cost-benefit type was only one.

Project identification and implementation were at least as crucial in determining the distribution impact of projects. What actually happens when we come to implementation rarely, if ever, corresponds to what was anticipated at the time of appraisal. Thinking of finance as the scarcest resource doesn't make sense in some countries. In practice, when you come to the implementation of projects, the scarcest resource is often found to be what one might call administrative capacity, or the capacity to get things done. This means that very bad decisions with serious effects can be taken on the basis of conventional cost-benefit analysis. For example, take a situation where a good extension program is getting through to the smaller farmers, and then a donor agency and a government agree on a new credit program. This credit program may take the extension staff off their work with the smallest farmers and concentrate them on giving supervised credit to those who need it least.

Aftab Khan said that appraising the benefit side of poverty-alleviating projects presented extremely difficult problems. In addition to the problems of defining appropriate weighting systems for different income groups and appropriate discount rates, the distributive impact of projects might be thwarted by the presence of powerful entrenched social and economic groups. The experience of the South Asian subcontinent showed that the benefits of rural development have primarily accrued to rich farmers. Unless the power of the rural vested interests was broken through radical land redistribution, widespread diffusion of the benefits of development was not possible. Much had already been written about the role of high-yielding varieties of wheat and other crops in aggravating rural inequalities. The benefits of fiscal measures designed to help small businessmen and industrialists were, to a significant degree, reaped by big businessmen through recourse to unscrupulous means and because of the "soft" administrative apparatus of many developing countries. Aid agencies should, therefore, give more attention to comparing ex-ante expectations with ex-post results.

R. Porter noted that it was very rare for an aid agency to be confronted with any array of projects and asked which one it was going to pick. What was much more common was the case where one had to devote quite a lot of time and effort working with the recipient government in seeking for and working out possible projects. This could be very time-consuming and costly. Feasibility studies could be very expensive, so that the question of turning down a project when it had actually been through this large number of stages of analysis was something which one did not do very lightly. It was an unusual case when a project was rejected after a large amount of time and energy had been spent on working it out. It was therefore at the earlier identification and selection stage that

the analysis ought to bite. But it was precisely at this stage that one was often confronted with severe data constraints, since initially there was often little more than a vague idea which one had to spend time and money working out. "This amounts to saying that the decision-making is not so much a decision of whether or not to go ahead with a particular investment, but rather whether or not it is worthwhile studying a particular proposal in order to turn it into an investment. It is wrong, however, to think that this irreversibility of investment decisions makes cost-benefit analysis superfluous; on the contrary, it has profound implications for the way in which it should be applied. At present, what commonly happens is that somebody decides to go ahead with a certain project, gets an engineer to design it, and then brings along an economist to justify the design. What should happen is that economic analysis be done before any piece of engineering takes place."

Concluding Remarks

Richard Jolly summarized what seemed to be the major points of agreement and disagreement among the participants. Firstly, there seems to be a strong consensus that income distribution and employment have to be allowed for somehow in the evaluation of projects, both as a point of development strategy within developing countries and as an appropriate point of emphasis for aid donors. Secondly, in the real world objectives are often ill-defined and conflicting, many key facts are unknown or uncertain, and careful analysis is often under pressure from the realities of power politics or the rush to get a decision made. Nobody suggested that those imperfections could be totally eradicated. The challenge is neither to ignore nor to succumb to them, but to explore ways to take them into account by adapting appraisal procedures to their reality. Thirdly, everyone agreed on the value and usefulness of cost-benefit analysis if appropriately used. No one regarded it as a total distraction or advocated its abandonment. In a world of scarce resources, there is a vital need for using resources efficiently. But the real value of a cost-benefit approach is not so much in leading to a 'yes or no' decision about a project at a specific moment of evaluation, but rather in influencing the whole process of project identification and implementation. Especially important is the need for cost-benefit analysis to illuminate the many early steps in the process of project planning which tend to commit one to a decision, even before the formal process of project evaluation had begun. Fourthly, no one really stated that judgment and common sense could entirely substitute for cost-benefit techniques as a means to decision-taking. Most seemed to agree that to pose one against the other was a false polarization, that a lot of judgment was needed in any application of cost-benefit analysis, but that judgments should be made within a framework of systematic and disciplined thought.

At the same time, important differences of opinion remained on a number of points. Firstly, there were clear differences on the relative weight to be given in different countries to major changes in development strategy, as opposed to the more efficient implementation of existing strategies. There were those who felt that more efficient project selection, implemented by the use of cost-benefit techniques as a way of selecting a better range of projects, would itself go a long way towards avoiding a continuation of the growing inequalities and growing poverty which has characterized the development pattern of the last 10 or 20 years. In contrast, others were convinced that this would be quite inefficient and might even exacerbate the situation: major changes in strategy were required, not merely greater efficiency. According to this view, one should start with the identification and clear adoption of these required changes, and then use cost-benefit and cost-effectiveness techniques to assist the efficient implementation of a new strategy. Cost-benefit techniques alone, for various reasons, would not achieve this reorientation of strategy, and might well retard it.

A second area of disagreement underlying many of the differences related to the question as to whether, in the actual applications of cost-benefit analysis, the attempts to weight different income distributions, to apply shadow pricing techniques, and to take account of externalities would or would not have much effect on the actual results of the calculation. As it happens, in the case studies presented at the conference, the results of the cost-benefit calculations were not much influenced by these adjustments. Whether this will be true for cost-benefit studies generally will of course be a matter of fact, not judgment. But at present, with relatively few case studies to go on, it is in part a matter of judgment on which opinions vary. Some believe that such techniques are, or at least could be very sensitive to issues of income distribution and externalities; others clearly do not.

Thirdly, participants disagreed on how economists and planning staff should best allocate their time between project appraisal and other aspects of project preparation and implementation. There was considerable agreement that, in the past, there had been excessive preoccupation with project appraisal to the neglect of the other stages in planning and implementation. But important differences remained as to whether economists should now shift their attention to other points in a centralized, "top-down" planning system--or whether they must develop quite new roles in a more decentralized, more participatory "bottom-up" decision-making and implementation process. This leads on to a fourth difference, the extent to which a change in strategy would also require a change of the existing administrative framework. Some thought that a lot could usually be done within present administrative structures,

while others seemed to believe that only minor changes were possible without a major transformation of existing administrative systems. Economists often analyze decision-taking as a purely logical process, in which political, administrative or social considerations enter merely as "constraints" on what otherwise is economically ideal or optimal. In contrast, political scientists or sociologists take the political and social as well as the economic elements as data which must enter into the objectives, as well as the constraints, when determining any solution. There should be a full integration of these disciplines.

Both proponents and antagonists of cost-benefit analysis agreed that only a very limited number of refinements to the basic method are practically feasible or desirable. But the very consensus on this point widens the differences on other points, because it reinforces the different views already taken on whether a limited form of cost-benefit calculation helps or hinders decision making on issues involving income distribution and externalities. Perhaps the most fundamental and controversial point at issue is the view that the very factors involved in analyzing an issue within a cost-benefit framework represent a distraction from more important issues central to the implementation of projects and policies that will effectively benefit the poor. These issues are those of technological linkage, administrative organization, and political power. The way a project is organized and relates to the local community may, in this view, be more important for its impact than its technical specifications. In principle, there is nothing inconsistent between preoccupation with such issues and approaching problems in a cost-benefit frame of mind, or even undertaking a cost-benefit analysis. In practice, however, one approach may quite often exclude the other, because the two frames of mind and the two sets of involvements are so different. The differing judgments on the importance of this are at the heart of the debate.

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